

Navy Research Inst. - this Day
H.H. R.J.

SCIENCE

SEPTEMBER 11, 1953

VOLUME 118

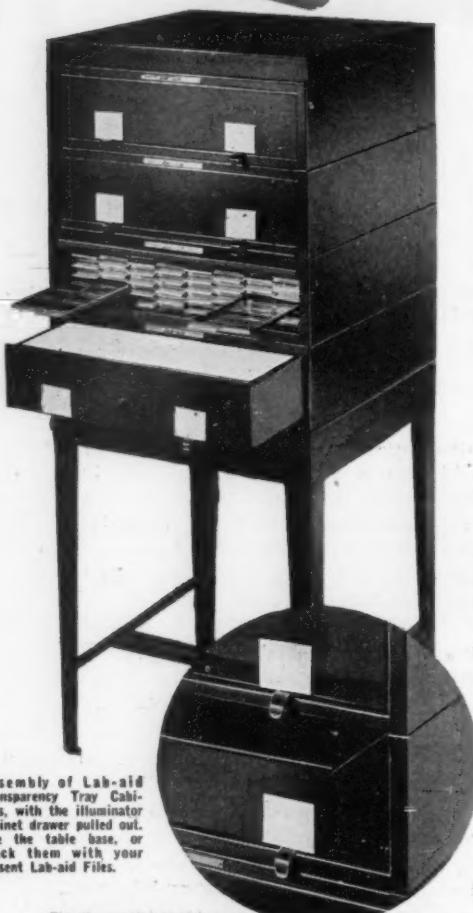
NUMBER 3063

Contents

Indiana Conference on Nuclear Spectroscopy and the Shell Model: <i>Emil J. Konopinski</i>	285
Walter T. Swingle: 1871-1952: <i>William Seifriz</i>	288
News and Notes	290
Technical Papers	
Preliminary Observations on Intraspecific Variation of the Levels of Total Protein in the Sera of Some Decapod Crustacea: <i>Charles A. Leone</i>	295
Occlusion of Copper and Zinc by Some Soil Materials of Lower Mississippi River Area: <i>V. P. Sokoloff</i>	296
Some Observations on the Pathogenicity of Isoniazid- Resistant Variants of Tubercle Bacilli: <i>Gardner Middlebrook and Maurice L. Cohn</i>	297
Radioactive Measurement of Proteolytic Activity: <i>George L. Nardi</i>	299
Various Absorption Coefficients for 23.5-Mev X-Rays: <i>V. S. Moos, W. J. Henderson, and J. W. Beattie</i>	300
The Dynamic Equilibrium between Circulating and Extravascular Plasma Proteins: <i>David Gitlin and Charles A. Janeway</i>	301
A Homogeneous Cell Preparation from Soybean Leaves: <i>D. W. Racusen and S. Aronoff</i>	302
Fructomaltose, a Recently Discovered Trisaccharide Isolated from Honeydew: <i>Henry E. Gray and G. Fraenkel</i>	304
Malignant Tumors Resulting from Embedding Plastics in Rodents: <i>B. S. Oppenheimer et al.</i>	305
Volumetric Flasks and Microcell Filling Adapter for Use with the Perkin-Elmer Infrared Spectrophotometer: <i>O. D. Easterday et al.</i>	306
Comments and Communications	
<i>Emil J. Baumann and David Marine; Donald M. Black; M. Rachel Harris; Margaret C. Irwin; and William R. Pitney, Everett H. Sanneman, and Marion F. Beard</i>	307
Scientific Book Register	310
National Register of Scientific and Technical Personnel	3
Publications Received	12
Meetings & Conferences	14

AMERICAN ASSOCIATION FOR THE
ADVANCEMENT OF SCIENCE

the new *Lab-aid* way to store and view
color
transparencies



Assembly of Lab-aid Transparency Tray Cabinets, with the illuminator cabinet drawer pulled out. Use the table base, or stack them with your present Lab-aid Files.

The disappearing shelf is convenient as a temporary resting place for slides while working with them.

Inspect all your slides without removing any of them, or even stirring from your place.

Other units in the Lab-aid line

- 1" MICROSLIDE DRAWER FILES
- 2" SLIDE OR TRANSPARENCY DRAWER FILE
- 4" SLIDE OR INDEX DRAWER FILES
- MICROSLIDE FLAT-FILING TRAY CABINET
- PARAFFIN BLOCK FILE

You know how efficiently Technicon Lab-aid cabinets bring order to the filing of microslides, paraffin blocks and associated materials in the pathologic laboratory.

Now, in this new addition to the Lab-aid Filing System, you can enjoy the same benefits in the filing and viewing of color transparencies and lantern slides. The new Lab-aid transparency file has 40 smooth-sliding flat trays, each holding 16 standard 2" mounts, or 5 3/4" x 4 1/4" lantern slides in full view. They're easy to insert . . . you just drop them flat in the grooved frames. Easy to remove, too, by popping them out from underneath.

The special cabinet with its pull-out illuminator lets you view a whole tray of transparencies at a glance, without removing any of them. Sitting or standing, you can inspect hundreds of slides under ideal viewing conditions without stirring from your place. And the disappearing shelf is a mighty handy place to lay slides down temporarily while you're working with them.

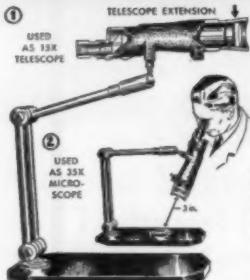
Both tray and illuminator cabinets are of the same dimensions and finish as all the other units in the Technicon Laboratory Filing System, and can be stacked interchangeably with them. If you would like more information about these or other units of the system, we'll be glad to send details.



technicon *Lab-aid* filing system

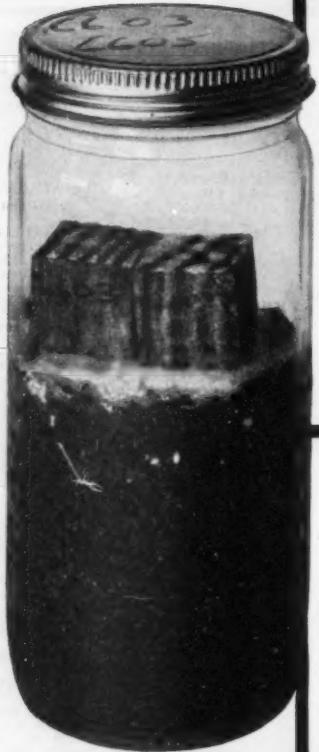
THE TECHNICON COMPANY
215 East 149th St., New York 51, N. Y.

SENSATIONAL OPTICAL BARGAINS



AMAZING! Double Utility! Combination 15X TELESCOPE and 35X Erecting MICROSCOPE

Extra utility by removing telescope portion and using as 35 power microscope to inspect, dissect, etc. Excellent clarity whether used as telescope or microscope. Telescope objective lens is achromatic, coated. Telescope can be removed and carried in pocket—focuses from 10 ft. to infinity. Microscope has 3 element, color corrected objective—image is erect—just as your eye sees it—not upside down as in an ordinary microscope. Ramsden eyepiece with coarse or fine focusing. Gives you 3" of working distance when used as microscope. This low price is possible only because we utilize some very high grade war surplus parts in manufacturing this fine instrument. Entire unit folds down to 2" x 7" x 10". Telescope instantly adjustable in height from 3" to 14". Stock No. 70,017-W \$29.50 Postpaid



THIS BOTTLE TURNS SEVEN YEARS INTO SEVEN MONTHS

Test blocks of pole wood are fed to destructive fungi in bottles like this at Bell Laboratories. Wood rests on soil which controls moisture conditions and promotes fungus growth. Test speeds search for better preservatives.

This year the Bell System is putting 800,000 new telephone poles into service. How effectively are they preserved against fungus attack and decay?

Once the only way to check a preservative was to plant treated wood specimens outdoors, then wait and see—for seven years at least. Now, with a new test devised in Bell Laboratories most of the answer can be obtained in seven months.

Cubes of wood are treated with preservatives, then enclosed in bottles with fungus of the most destructive kind, under temperature and humidity conditions that accelerate fungus activity. Success—or failure—of fungus attack on cubes soon reveals the best ways to preserve poles.

The test has helped show how poles can be economically preserved for many years. It is another example of how Bell Telephone Laboratories works to keep down your telephone costs.

A boring is taken from a pole section to see how far preservative has penetrated. For poles to last, it must penetrate deeply and be retained for a long time.



**BELL TELEPHONE
LABORATORIES**

Improving telephone service for America provides careers for creative men in scientific and technical fields.



National Register of Scientific and Technical Personnel

THE registration of scientists, as with other inventories of our scientific potential, must be accomplished by methods consistent with the protection of the traditional freedoms fundamental to the continued advancement of science. In keeping with this philosophy, the professional scientific societies, representing scientists, and the National Science Foundation, representing Government, have identified a mutual interest in cooperatively developing uniform registers of scientific and technical personnel in the various fields of science. The primary purposes of the registers are: 1) to provide standby machinery for the location of scientific talent in the event of a national emergency, and 2) to provide scientific manpower information necessary for the development of policies regarding science. Some professional scientific societies plan additional uses for the registers in connection with their placement programs, to facilitate and to provide a broader base for special surveys of particular interest to the society, to assist in the compilation of society directories and in the furnishing of information for biographical directories.

Accordingly, in the fall of this year several professional scientific societies, with the aid of grants from the Foundation, will begin to distribute to member and non-member scientists in their respective fields brief questionnaires on their educational, technical, and professional backgrounds. The information provided on the returned questionnaires will serve as the basis for decentralized registers to be housed and maintained in the offices of the societies.

The composite of these individual registers will form the National Register of Scientific and Technical Personnel to implement that section of the National Science Foundation Act of 1950, which authorizes and directs the Foundation "to maintain a register of scientific and technical personnel and in other ways provide a central clearinghouse for information covering all scientific and technical personnel in the United States."

SCIENCE, founded in 1880, is published each Friday by the American Association for the Advancement of Science at the Business Press, 10 McGovern Ave., Lancaster, Pa. Entered as second-class matter at the Post Office at Lancaster, Pa., January 13, 1948, under the Act of March 3, 1879. Acceptance for mailing at the special rate postage provided for in the Act of February 28, 1925, embodied in Paragraph (d-2) Section 34.40 P. L. & R. of 1948. All correspondence should be sent to **SCIENCE**, 1515 Massachusetts Ave., N.W., Washington 5, D.C. The AAAS assumes no responsibility for the safety of manuscripts or for the opinions expressed by contributors. Four weeks' notice

Ruth C. Christman
Acting Executive Editor

AAAS EDITORIAL BOARD
(Terms expire June 30, 1954)

William L. Straus, Jr.
Acting Chairman

Mark H. Adams Bentley Glass
William R. Amberson Karl Lark-Horovitz
Wallace R. Brode Edwin M. Lerner
Walter J. Nickerson

F. A. Moulton, Advertising Representative

Previous rosters and registers, including the Roster of Scientific and Technical Personnel (1940-47), registrations of scientists and engineers sponsored by the military services (1947-50), and the National Scientific Register (1950-52), were undertaken primarily to meet short-term emergency needs. The present register has been designed as a long-range, continuing program, decentralized, yet flexible enough to serve emergency needs. Normally, registration will cover personnel having four or more years of professional experience in a scientific or technical field beyond the baccalaureate degree or its equivalent. Registrants will be canvassed periodically in connection with those items of background information which are likely to have changed, in order to keep the records up to date.

Four organizations are now actively engaged in this new program: the American Geological Institute; the American Institute of Biological Sciences; the American Veterinary Medical Association; and the Federation of American Societies for Experimental Biology. Others who are formulating their plans for cooperation in the register are: the American Chemical Society; the American Institute of Physics; the American Mathematical Society; the American Meteorological Society; The American Psychological Association; and the Engineers Joint Council. The American Medical Association has indicated that it will cooperate with the biological groups in the registration of medical scientists. Special procedures will be devised to register any qualified scientific or technical group not associated with the societies named above.

The present registration program has received the warm approval of specialists on scientific manpower and of the professional and scientific organizations. Its success will depend upon the cooperation of scientists and technical personnel in completing and returning the brief questionnaires sent to them. Scientists who do not receive questionnaires may assist in the program by requesting the appropriate professional scientific society, institute, federation, council or association to include them in its mailing list.

HARRY C. KELLY

National Science Foundation, Washington, D.C.

is required for change of address, and an address stencil label from a recent issue must be furnished. Claims for a missing number will be allowed only if received within 60 days from date of issue.

Annual subscriptions, \$7.50; single copies, \$2.25; foreign postage, outside the Pan-American Union, \$1.00; Canadian postage, \$0.50. Special rates to members of the AAAS.

The AAAS also publishes THE SCIENTIFIC MONTHLY. Subscription and advertising rates on request.

Cable address: ADVANCESCI.

GBI

Reg. U. S.

Pat. Off.

ENZYMES

Acetyl Cholinesterase (20,000 U vial)
 Amylopsin 3 U.S.P.
 Alpha Amylase
 Beta Amylase
 Catalase Crystalline
 Chymotrypsin Crystalline
 Cocarboxylase
 Cozymase (coenzyme I) 65% Pure
 Cozymase (coenzyme I) 90% Pure
 Cytochrome C (amorphous Powder)
 Cytochrome C (liquid)
 Diastase (malt)
 Desoxyribonuclease 1× Cryst.
 Emulsin
 Erepin
 Ficin
 Glucuronidase
 Hemicellulase
 Hyaluronidase
 Invertase
 Invertase (Analytical grade with Melibiose)
 Invertase (Analytical grade without Melibiose)
 Lipase
 Mycozyme
 Mylase P
 Pancreatin
 Papain Powder
 Pectinase
 Penicillinase
 Pepsin 1 : 10,000
 Pepsin, 2× Crystallized
 Phosphatase
 Protease
 Rennet N. F.
 Ribonuclease, Crystalline
 Soybean Trypsin Inhibitor, 5× Crystallized
 Triphosphopyridine Nucleotide
 (approx. 65% pure)
 Triphosphopyridine Nucleotide
 (approx. 80% pure)
 Trypsin 1× Cryst.
 Trypsin 2× Cryst.
 Trypsin 2× Cryst. (salt free)
 Trypsin 4 U.S.P.
 Trypsinogen 1× Cryst.
 Urease Powder
 Uricase Powder

A READY REFERENCE
 That will Save Time for You



WRITE FOR
YOUR COPY
TODAY

Use this catalog as a "one stop" source of Amino Acids, Vitamins, Carbohydrates, Adenylates, Nucleates, Purines, Pyrimidines, Tetrazolium Salts, Enzymes, Microbiological and Bacteriological Media, Complete Animal Test Diets and Ingredients for investigational use.

GENERAL BIOCHEMICALS, INC.
 60 LABORATORY PARK • CHAGRIN FALLS, OHIO

E & G
MICROSCOPE
LAMP
 model 1

... recognized throughout the sciences as the most versatile and efficient source of transmitted and incident light for routine microscopy. A cool burning, intense, dependable lamp, the E & G Model 1 features low voltage, compactness, focusing device, built-in iris, daylight filter and multiple filter holder. Buy this high quality illuminator at leading scientific dealers or from manufacturer direct.

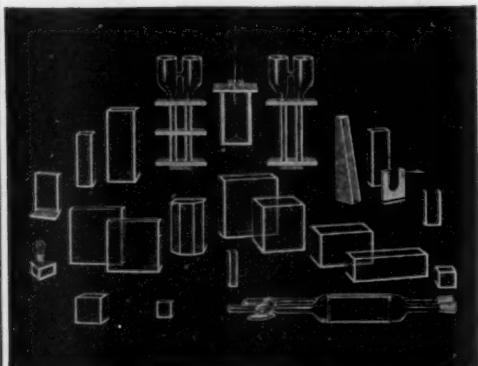


Write for literature
 describing E & G
 Illuminators

ERB & GRAY

854 S. Figueroa St. • Los Angeles 17, Calif.

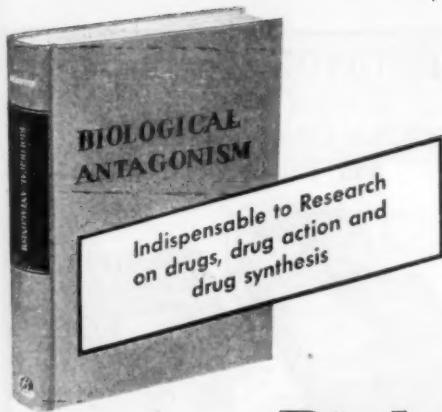
GLASS ABSORPTION CELLS made by **KLETT**



Makers of Complete Electrophoresis Apparatus

SCIENTIFIC APPARATUS
 Klett-Summerson Photoelectric Colorimeters—Colorimeters—Nephelometers—Fluorimeters—Bio-Colorimeters—Comparators—Glass Standards—Klett Reagents.

Klett Manufacturing Co.
 179 East 87 Street, New York, New York



*Every Researcher
in biology, drugs
medicine, endocrinology
or allied sciences
should have a copy of*

MARTIN'S Biological Antagonism

by GUSTAVE J. MARTIN, PH.D., Research Director
The National Drug Company, Philadelphia

In this most comprehensive volume of 1900 references, Dr. Martin presents a theory of biologic relativity as the basis of antagonism, *its central concept being that specificities in any biologic system are RELATIVE not absolute.*

BIOLOGICAL ANTAGONISM gives the information necessary for replacement drugs or antagonistic drugs for counteracting adverse effects. It covers antagonisms as observed in the field of amino acids, purines, pyrimidines, vitamins, hormones and minerals. It describes the relationship between pharmacology, physiology and chemistry in such studies. It is THE research volume every researcher in biological work must have.

516 pages, 44 tables, 64 figures

\$8.50

**THE BLAKISTON COMPANY, INC.
GARDEN CITY, NEW YORK**

Please send me _____ copies of Martin's BIOLOGICAL ANTAGONISM \$8.50

You SAVE Postage by Sending Check or Money Order

Check or M.O. Enclosed Charge My Account
 Send C.O.D.

Name

Address

City Zone State



Sci. 9-11-53

HORMONE ASSAYS

ACTH • Growth • Gonadotropes
Estrogens • Androgens
Corticoids • Progesterone
Others

HYPOPHYSECTOMIZED RATS • ENDOCRINE TOXICITY TESTS

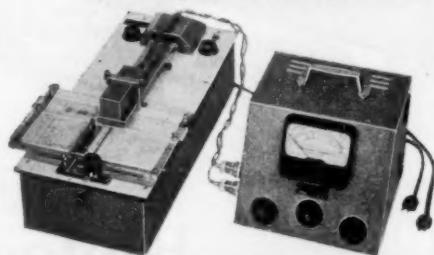


Write for details

ENDOCRINE LABORATORIES
OF MADISON, INC.

5001 W. BELTLINE HIGHWAY • MADISON, WISCONSIN

PHOTOVOLT Densitometer for Partition Chromatography and Paper Electrophoresis

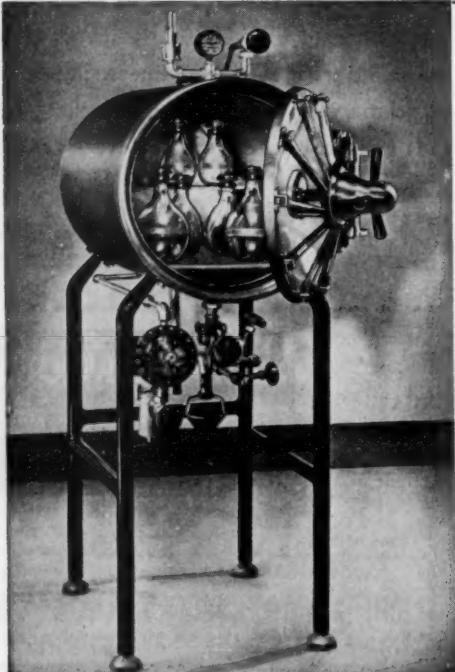


A photoelectric precision instrument for the rapid and convenient evaluation of strips and sheets of filter paper in partition chromatography and paper electrophoresis

Write for Bulletin #800 to

PHOTOVOLT CORP.
95 Madison Ave. New York 16, N. Y.

Also: Colorimeters | pH Meters | Multiplier Photometers
Fluorimeters | Nephelometers | Interference Filters



When ACCURACY is important . . .

CASTLE AUTOCLAVES are ideally suited to precision laboratory work because uniform temperature is rigidly maintained throughout the chamber. This temperature is selective at any point from 212°F. to 260°F., hence adaptable for all routine and research work.

SINGLE WALL TYPE is generally suitable for laboratory procedures. It is equipped with condenser hood which prevents moisture dripping on contents.

DOUBLE WALL TYPE gives you the drying effect of a separate pressure jacket. This type can be used for general surgical purposes.

Interior equipment to meet your requirements. Write: Wilmett Castle Co., 1212 University Ave., Rochester 7, N. Y.

Single wall No. 1826-L

Castle Bacteriological Apparatus

IT'S
STANDARD
PROCEDURE
to make
STANDARD
Your Source
of Supply

STANDARD'S SPECIALS of the MONTH!

Keeping Pace with your Laboratory Needs!



EIMAC Diffusion Pump

The Eimac HV-1 Diffusion Pump is a fast, triple-jet air-cooled vacuum pump of the oil-diffusion type. When used with a suitable mechanical forepump and Eimac type A oil it is capable of reaching an ultimate vacuum of 4×10^{-7} mm of mercury. The glass construction permits rapid inspection of conditions within the pump.

APPLICATIONS OF THE EIMAC PUMP
EVACUATING Electronic vacuum tubes, etc.,
METAL TO CERAMIC BRAZING, METALIZING BY EVAPORATION, DISTILLATION OF VITAMINS, VACUUM SMELTING AND CASTING, ANTI-REFLECTIVE COATING, VACUUM SINTERING OF METALS, OBTAIN OPERATING PRESSURE of cyclotrons and Y-12, FREEZE-DRYING OF BIOLOGICALS.

FEATURES OF THE "EIMAC" PUMP

Pyrex Glass Barrel—Readily enables inspection of oil rings and internal operating conditions.

Simple Cleaning—This factor is one of the most important to pump users. The "EIMAC" can be disassembled in a matter of minutes without special tools. Normal cleaning procedure is 100% effective as there are no inaccessible areas. (With metal-barreled pumps inspection is difficult and effectiveness of cleaning can be determined only after pump has been returned to service.)

No refrigerant—The "EIMAC" is entirely air cooled with the cooling accomplished from the draft of a small fan.

No Charcoal Trap—The unique cold-baffle prevents entrance of oil vapor in the high-vacuum manifold.

Pipe-Flange Mounting—Both high-vac and fore-pump manifold connections match standard pipe flanges.

110 Volts AC-DC—No complicated electrical circuit is required as the heater operates on standard 110 volt power.

No. 84570 Complete assembly includes flanges and nipples with gaskets and complete instructions Price \$125.00

No. 84571 Special type A pump oil Quart \$5.00

VACUUM INDICATING GAUGE



This equipment which is designed to operate with the RCA type 1946 thermocouple gauge tube or equivalent, measures pressures in the range .001 to 1 mm Hg. The meter is calibrated to read air pressure directly. The unit is operated on 110 volt, 60 cycle ac, and consumes approximately 10 watts. It is mounted in a sloping front cabinet $6\frac{1}{2}'' \times 10'' \times 6\frac{1}{2}''$.

Operation is particularly simple. Calibration is checked by use of the same meter that reads the pressure. A ballast type circuit is employed in order to minimize error due to line voltage variation.

The thermocouple tube may be sealed directly to pyrex systems. An adapter (listed below) is available for use in connecting the tube to metal vacuum systems.

In addition to use as a pressure indicator, the gauge is useful for locating leaks in vacuum systems by noting sudden changes in reading when a material such as acetone is sprayed or painted on the suspected part of the system.

No. 84572, less thermocouple tube \$69.50

Thermocouple tube, complete with plug to match above gauge circuit \$12.50

Thermocouple tube, complete with plug and adapted for metal systems \$15.00

For Safe, More Efficient Heating IN ALL LABORATORY APPLICATIONS! THE NEW STANDARD HEATER WITH BUILT-IN REGULATOR

the only heater on the market with CONTROLLED TEMPERATURE—NOT CONTROLLED CURRENT:

SELF-SUPPORTING WITH BUILT-IN ROD CLAMPS

The Standard Heater incorporates all the features of safety, durability and efficiency to satisfy the most discriminating research man. Features the BUILT-IN clamp, two of which are included with each unit.

Cat. #	Cap. ml	Watts	Volts	Wt.	Price
64356A	500	400	125	3#	\$35.00
64356B	1000	600	125	4#	39.50
64356C	2000	800	125	5½#	44.30
64356D	3000	800	125	7#	51.50
64356E	5000	1000	125	9#	68.60
64356F	12000	1400	125	16#	95.00
64356G	22000	1400	125	21#	135.00



- CANNOT GET TOO HOT
- DELIVERS FULL RATED WATTAGE
- SAFE—PROTECTS FLASKS PROTECTS OPERATOR



STANDARD SCIENTIFIC SUPPLY CORP.
34 West 4th Street • New York 12, N.Y.

LABORATORY APPARATUS — REAGENTS AND CHEMICALS



**METHYLAMINOACETOCATECHOL
3-METHYLTIOPHENE
NOREPINEPHRINE
NORLEUCINE
ORNITHINE
PEPSIN
PHENYLALANINE
PROBIT PAPER
PROTARGOL-S**

For the rest of the Winthrop
Alphabet send for 1953 Price List

Special Chemicals Division

Winthrop-Stearns Inc.
1450 Broadway, New York 18, N. Y.

**TIME PROVEN
LaMOTTE SOIL
TESTING APPARATUS**

The result of 30 years of extensive cooperative research with agronomists and expert soil technologists. The methods used are based on fundamentally sound chemical reactions adapted to the study of soils, and have proved invaluable aids in diagnosing deficiencies in plant food constituents.

Methods for the following tests are available in single units or in combination sets:

Ammonia Nitrogen
Nitrate Nitrogen
Nitrite Nitrogen
Available Potash
Available Phosphorus
Chlorides
Sulfates

Iron
pH (acidity and alkalinity)
Manganese
Magnesium
Aluminum
Replaceable Calcium

Tests for Organic Matter in Soils, and Nutrient Solutions (hydroculture) furnished only as separate units.

The New LaMotte Soil Sampling Tube

This New Soil Sampling Tube has been designed by experts. It is sturdily built of non-corrodible metals, light in weight (3½ lbs.) and calibrated in 6" intervals for accurate soil sampling to any depth to 3 ft. Plastic Vials with screw caps, for containing soil samples may also be had.

Information on LaMotte Soil Testing Equipment
will be sent upon request.

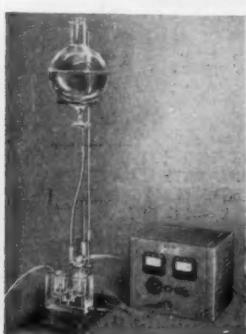
LaMOTTE CHEMICAL PRODUCTS COMPANY
Dept. "H" Towson, Baltimore 4, Md.



Paper Partition CHROMATOGRAPHY

**The Reco
CHROMATOGRAPHY
DRYING OVEN**

A mechanical convection oven designed for heating paper chromatograms.



**The Reco
ELECTRIC
DESALTER**

For the removal of inorganic salts from organic and amino acid solutions to be chromatographed.

RACKS
Stainless steel or glass for one dimensional chromatography.

INDICATOR SPRAYS
For application of indicators to chromatograms.

CLIPS
All stainless steel spring clips for holding chromatograms to glass rods.

SOLVENT TROUGHS
For use in chromatocab or one-dimensional racks.

ALSO AVAILABLE:

Densitometers . . .
for quantitative determinations on paper
Ultraviolet Lamps
Pyrex Disc Chambers
Micro Pipets
Chromatocab

A General Catalogue of the RECO Line of Paper Partition Chromatographic Equipment Is Available on Request.

Research Equipment CORPORATION

DEPT. S • 1135 THIRD STREET, OAKLAND 20, CALIFORNIA • TWINDAKS 3-0556

arch
ound
have
plant
single
inity)

hydro-

y ex-
light
s for
Vials
so be

ANY
4, Md.

gue
of
n
ic
uest.

September 11, 1953

LOOK INTO THE NEW LEITZ STEREO-BINOCULAR MICROSCOPE



It's new... modern... up-to-the-minute! It's streamlined... sturdy... packed with new features!

One... inclined binocular body tube and adjustable interpupillary distance for more comfortable viewing.

Two... new, improved prism system in stereo tube for better image quality.

Three... new rapid-changing device for three objectives.

Four... objectives protected from damage by new type mountings.

Five... binocular body can be rotated through 360 degrees for use with offset arm stand.

Six... redesigned bearing and special steel sliding surfaces insure long trouble-free performance.

Seven... large, 60mm diameter mirror, adjustable for any desired viewing effect.

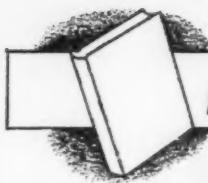
Eight... stand of new design with removable stage plate for examining specimens of all sizes.

Nine... special reflected-light illuminators.

Ten... focusing adjustment moving surfaces are large to insure accurate focus. And many more!

Your Leitz dealer will be glad to show you this modern new Leitz Stereo-Binocular Microscope. Call him soon.

E. LEITZ, INC., 468 Fourth Avenue, New York 16, N. Y.
Distributor of world-famous products of Ernst Leitz, Wetzlar, Germany
Cameras • Lenses • Microscopes • Binoculars



new book announcements

McGRAW-HILL BOOK COMPANY

THE ACTINIDE ELEMENTS

By GLENN T. SEABORG, University of California, Berkeley, and JOSEPH J. KATZ, Argonne National Laboratory, Chicago. *National Nuclear Energy Series*. Division IV, Volume 14A. Ready in October.

Offering material available in no other work, this outstanding comprehensive survey covers detailed discussions of the chemistry of all the elements from actinium to the newly-discovered trans-plutonium elements. Exhaustive and critical treatment is given to the important nuclear properties of the many isotopes of these elements with special attention to comparative chemistry, crystallography, oxidation-reduction behavior, and nuclear systematics.

ELECTRICITY AND MAGNETISM

By EDSON R. PECK, Northwestern University. 470 pages, \$7.50

This intermediate text provides an unusually careful, clear, and critical discussion of the underlying principles of electromagnetism, including both field and circuit theory, and goes as far as simple applications of the Maxwell equations to electromagnetic waves and radiations. A background in general physics and elementary calculus is assumed. Although primarily theoretical, the book maintains contact with the laboratory by means of numerous practical problems.

CRYSTAL DISLOCATIONS

By W. T. READ, JR., Bell Telephone Laboratories, Inc. *International Series in Pure and Applied Physics*. 219 pages, \$5.00

A specialized text and reference in a very important phase of solid state physics, this volume is written for physical metallurgists and physicists interested in the phenomena associated with imperfections in the crystal structure. It explains what dislocations are, what they do, and how they produce effects which one can study experimentally. Emphasis is upon a systematic introductory account of what is definitely known about dislocations.

WILDLIFE MANAGEMENT: Fur Bearers, Waterfowl, and Fish. Volume II

By REUBEN E. TRIPPENSEE. *American Forestry Series*. 552 pages, \$7.50

This second and final volume of the authoritative study concisely brings together pertinent facts on management of water and wet lands; life histories, ecology, and management of fur bearing animals, waterfowl, and freshwater game fish, and presents necessary procedures for their abundant production and orderly harvest. Descriptions of their habitats are also included. Outstanding illustrations show points of both beauty and interest.

Send for copies on approval

McGRAW-HILL BOOK COMPANY

330 West 42nd Street

• New York 36, N. Y.

Indiana Conference on Nuclear Spectroscopy and the Shell Model

Emil J. Konopinski

Department of Physics, Indiana University, Bloomington, Indiana

THE CONFERENCE was held at Indiana University, May 14-16, 1953. It was initiated and organized by A. C. G. Mitchell, head of the Indiana University Physics Department, and was supported by the Office of Naval Research. Over one hundred representatives of twenty-seven laboratories attended. The four sessions were presided over by Gregory Breit, Martin Deutsch, Eugene Greuling, and D. R. Hamilton. Twenty-five lectures introduced the topics for informal discussion.

The discussions were concentrated on interpreting the vast accumulation of data, obtained by nuclear spectroscopy and allied techniques, concerning the behavior of transforming nuclei and their radiations.

Discussions of the Nuclear Model. The primary basis of interpretation was the shell model. However, this has to be greatly elaborated and supplemented beyond its primitive, initial form, owing to the growing refinement of the data.

Initially, only states of nuclei containing odd numbers of nucleons were determined. These were taken as completely characterized when the last odd nucleon was assigned to an orbit; all the paired like nucleons were regarded as inert. Obviously, the model could be extended to nuclei with even numbers of nucleons only by considering the coupling of at least the last two nucleons to determine the state. The more detailed evidence on the nature of actual nuclear states forces the consideration of all the nucleons in at least the last orbital, for some of the states.

Particular members of the paired like nucleons, the famous "magic numbers" 2, 8, 20 (28), 50, 82, and 126, show extra stability: each may be regarded as completing a particularly inert core, in the nuclei containing it. The extra nuclei form a sort of "atmospheric" envelope, stratified into orbital shells.

Before the advent of the shell model, at least the heavier nuclei were treated as deformable "liquid drops" with some success. This model naturally failed to exhibit the marked shell effects which are observed, hence now the liquid drop treatment is accorded only to the magic number core, usually lumped together with the lower, filled shells of the "atmosphere." An excitation of the nucleus may still involve only the nucleons in the last, unfilled shells, as supposed in applications of the pure shell model. However, "tidal waves" in the fluid core can now be conceived to be induced by the "atmospheric" motions. The so-called

collective model of the nucleus treats some states as arising from a coupled motion of core and "atmosphere."

Not all these details which have come to light play significant roles in every experiment. The interpretations made at the conference exhibited every stage of the above picture, according to the elaboration of detail demanded by the individual experiments. Thus, only the orbit of the *last odd* nucleon needed to be considered in interpreting many of the facts. Examples given the most attention were:

1) L. Nordheim showed the existence of a significant difference in the allowed beta decays of two types of odd nuclei. If the transforming nucleon is the *last odd* one of both the parent and daughter nuclei then a comparatively rapid decay ensues. The second type is never as rapid: "rearrangement" transitions, in which a pair of like nucleons must be broken up and a new pair formed. [A case (Kr^{80}) of very marked delay by rearrangement was pointed out earlier by Goldhaber.]

2) H. Richards described experiments determining which excitations of a given nucleus involve only the *last odd* nucleon, and which engage the core. Protons are scattered inelastically from filled-shell nuclei. A wide resonance shows up at each energy which characterizes a single particle state of excitation, of the joint proton-target nucleus system. The longer-lived states in which the whole nucleus shares the excitation energies show distinctly narrower resonances.

3) M. Goldhaber compared odd nuclei which differ only in the number of neutron pairs underlying the *last odd* nucleon. The energy differences between single particle orbits in these nuclei vary smoothly as the neutron pairs are added in the given series. Quite reasonably, the orbits which come closest to the core are affected the most when it changes. J. Mihelich described an experiment in which a whole series of nuclei differing only by neutron pairs are obtained at once. This was the high-energy proton bombardment of gold, which yields the series by ejecting 1, 3, 5, or 7 neutrons.

Nuclei with both an odd neutron and an odd proton present the problem of the coupling between these in determining the nuclear state.

4) Nordheim showed that the coupling depends on whether each odd particle spins in the same or opposite direction to the orbital rotation. If the two odd

nucleons behave differently in this respect than they tend to cancel each other's angular momentum. Such nuclei have allowed beta decay to the spinless states of their daughters. If the two odd nucleons align themselves relative to their orbits in a like way, then a state of high angular momentum is produced. Such nuclei prefer to decay to highly spinning, excited states of their daughters to avoid overcoming the large angular momenta.

5) P. Hough described an experiment which determines directly the kind of orbit which a neutron enters when attached to a nucleus. If the neutron is one stripped from a deuteron bombarding the nucleus, then the freed proton's direction reveals the character of the neutron's new orbit. When the nucleus already has an odd proton, then it is found that the neutron, although entering its expected orbit, spends a few per cent of its time in an orbit of lower momentum.

Evidence about some nuclear states can be understood only if it is supposed that *all* the nucleons in unfilled shells participate in determining the character of the state in question.

6) E. Feenberg showed how an outstanding difficulty of the shell theory can be cleared up in this way. If only the odd proton of F^{19} is held responsible for its observed spin and magnetic moment, then it must be ascribed a spherically symmetric distribution (S orbit). Yet other nuclei, with equivalent proton or neutron numbers, show that the proton should prefer a higher angular momentum (a d orbit). Now, if *all* the protons which would go into the d orbit are considered together, then this preferred d-orbit assignment works as well as the S-orbit in yielding the correct spin and magnetic moment.

7) M. Mayer showed a striking correlation, between rates of favored beta decay and magnetic moments, which can be obtained by considering contributions of *all* the nucleons to the state character. Both the decay rates and the magnetic moments are extremely sensitive to similar details about the nuclear states. Each type of data shows erratic deviations from the expectations based on necessarily oversimplified state models. However, these two types of erratic deviations are now shown to be closely correlated with each other, qualitatively and quantitatively.

8) A long-standing difficulty for the shell model has been the explanation of why only a certain well-defined group of nuclei shows a favored rate of beta decay. Mayer pointed out that all unfavorable decays involve nuclear states which should be determined by at least three like nucleons. The various states which these form differ markedly in symmetry from states into which they decay, high degrees of symmetry being encouraged by the charge independence of nuclear forces. The great alterations needed to transform one type of symmetry to another are supposed responsible for the transformation's being unfavorable (violation of isotopic spin conservation).

The gross liquid drop picture of the nucleus is still adequate for understanding fission.

9) J. Brolley described experiments in which fast neutrons were sent against fissionable nuclei. The neutron, as might be expected, induces fore-and-aft oscillations in the "liquid drop" nucleus. This was shown by the preferential ejection of the fission fragments along the direction of the impinging neutrons.

The *collective* motion of fluid *core* and extra-core nucleons clarified many problems.

10) G. Scharff-Goldhaber demonstrated that practically all nuclei with even numbers of neutrons and protons have lowest excitations into even states with two units of angular momentum; the next higher excited states have four units of angular momentum in about a third of the cases, and two units again in another third. K. Ford showed that the *collective* model leads one to expect a first excitation consisting of a *core* rotation with just the two units of momentum found. Four units is one of the alternatives for the second excited state, depending on the extra-core nucleons available for excitation.

11) Goldhaber presented a striking analysis of an odd nucleus (Mo^{95}) which behaves like the even nuclei described in (10). Mo^{95} is exceptional in that it has a highly excited state with a long duration (isomer), yet it has just one neutron outside a magic number core. The long-lived isomers otherwise occur only just *before* the completion of such a core. It seems that it is the extra neutron that is inert during the pertinent excitations of Mo^{95} . The *core* meanwhile goes through the excitations (two, four, and eight units of spin) characteristic of an even nucleus, minus the extra neutron.

12) Scharff-Goldhaber also showed that the first excitations of the even-even nuclei need the most energy when there are fewest nucleons outside the magic number cores. The energy needed is uniformly very low when there are many extra-core nucleons. This conforms to Ford's expectations based on the *collective* model. Many extra-core nucleons pulling tidally on the *core* make it more easily deformable and excitable.

13) Ford also discussed the effect of the *collective* motion on the magnetic moments that deviate from expectations based on single nucleons outside an inert core. Ford could account roughly for the deviations, but only with the added presumption that the presence of many nucleons suppresses the magnetic effects of the meson clouds around each nucleon.

14) *Core* excitation also shows up in the experiments discussed by Hough (5): as a large background (30 to 50 per cent) of isotropically ejected protons. Breit pointed out how large an effect the interference of those protons may have, with the protons analyzed by Hough.

Discussions of the Laws of Beta-Radiation. 1) R. Sherr summarized the evidence that beta decay is allowed, and even favored, between spinless nuclear states. Such transformations require either a *scalar* or a *vector* form of coupling law between nucleons and beta particles (Fermi coupling). This must be

added to the well-established Gamow-Teller coupling (*tensor* or *axial vector* form of law). Mayer (7) also had evidence for the two types of coupling. Only the Gamow-Teller type can be correlated with magnetic moments and she found that a Fermi coupling contribution had first to be subtracted before she found her strong correlations between decay rates and magnetic moments.

2) E. Konopinski summarized the evidence that the particular forms of the two couplings are the *scalar* and *tensor*, and not the polar or axial vector forms. His earlier evidence, promulgated with Mahmoud, was based largely on the statistical sharing of energy exhibited in certain types of transitions (once forbidden). Measured correlations between the decay fragments of helium definitely now support the tensor over axial vector form of Gamow-Teller coupling.

3) Konopinski also discussed the pros and cons of the single piece of evidence (spectrum of RaE) that a third component of coupling, a *pseudoscalar* form, must also be added to the beta interaction. The third component is needed to interfere destructively with the others, to account for the slow decay of RaE (as well as for the peculiar spectrum). H. Brysk presented calculations showing that destructive interference in RaE entails constructive interference in Tl²⁰⁶ and, indeed, the latter element has the shorter life expected from this. Nordheim showed that the observed once-forbidden transitions with no spin change are faster than those with a change of spin. This added speed can be attributed to the *pseudoscalar* component, which acts in once-forbidden transitions only when there is no change of spin.

4) L. Langer described a measurement of an electron spectrum (distribution in energy) which, if correctly interpreted, may lend support to Konopinski and Mahmoud's interpretation of once-forbidden transitions (2). However, this measurement (Sb¹²⁴) is complicated by disagreements about the gamma rays emitted with the beta particles. E. Tomlinson includes two 700-kv gamma rays in his decay scheme for Sb¹²⁴, whereas Langer has evidence for only one. F. Metzger reported gamma-gamma coincidence measurements in support of Tomlinson's scheme.

5) Konopinski further discussed the results of carrying over the beta decay law, in the form found, to the decay of muons. He first presented theoretical arguments that the two neutral particles ejected in muon decay are like neutrinos. The result is a prediction of an ejected electron energy distribution which agrees with some of the mutually contradictory measurements (those finding the fewest high-energy electrons).

Discussions of the Laws of Gamma Radiation. Unlike the laws of beta radiation, the basic laws of electromagnetic radiations are well known. The problems arise in the attempts to apply them correctly. When the nucleus is regarded as a classical distribution of charges and currents, then certain expectations arise: radiations which carry off the more angular momenta

should be the weaker; the magnetic type of radiation is expected to be only as strong as the electric type which carries off one more unit of angular momentum. In more realistic pictures of nuclei, the classical relation between electric and magnetic radiations is lost; this is to be expected, for example, when one considers the extra contributions to magnetic radiation to be expected from the intrinsic magnetic moments of individual nucleons. One has well-defined expectations only when the radiation is attributed to transitions between single particle states. Hence the comparisons with the facts are usually made against the single particle model.

1) A. Sunyar demonstrated that the single particle expectations greatly overestimate the rate of electric dipole radiation (the electric type which carries off one unit of angular momentum). To do this, he identified nine transitions, of the type in question, which follow after beta decay.

2) Goldhaber pointed out that magnetic gamma radiations are an approximately constant factor weaker than as predicted by the single particle model. Their variation with energy closely parallels that of the model. On the other hand, the electric types of radiation vary erratically. This has consequences for the mixtures of electric and magnetic radiations which may occur. Most often, both types are about equally strong when they have the same multipolarity (dipole, quadrupole, etc., an index of the maximum angular momentum carried off). This accounts for the comparative rarity of mixtures, since both cannot occur in a given transition when they have the same multipole character. However, because of the erratic behavior of the electric intensities, some mixtures do occur. Sometimes the classical expectations of an electric multipole mixture with the next lower magnetic multipole occurs. More recent is the finding that also, in some cases, the electric multipole is mixed with the next higher magnetic multipole.

3) Mihelich described a neat experimental method for comparing multiplicities. He compares the efficiency with which the gamma rays kick out atomic electrons from two types of orbits (L_I against L_{II} , III). The ratio of ejections from one type of orbit to the other is small for electric quadrupole radiation, large for magnetic dipole radiations. A ratio approaching unity is a sensitive indication that the gamma radiation is a mixture of the two kinds.

A conspicuous example of the refinements being achieved in nuclear spectroscopy are the measurements of directional correlations between successive radiations.

4) R. Steffen described experiments on the directional correlation of successive gamma radiations. This turns out to be very sensitive to small degrees of mixing of the radiations. He found examples of both the types mentioned by Goldhaber (2). He stressed that the strong admixture of electric quadrupole radiation with magnetic dipole is evidence of core excitation, as discussed by Ford.

5) M. Rose suggested a means of avoiding one difficulty which besets the correlation of successive radiations. The difficulty is that the nucleus may be randomly disoriented by external effects in the stage between the successive radiations. He suggests using the ratio of the gamma-gamma correlations, to correlations between one gamma ray and an atomic electron kicked out by the second. Both types of correlations are identically affected by the nuclear disorientation.

6) Rose also discussed the very sensitive method of correlating the direction of one gamma ray with the polarization orientation of the other. He laid down the general rules for interpreting such measurements.

A more comprehensive report of the above proceedings has been prepared. A limited number of copies are available at the Indiana University Physics Department.



Walter T. Swingle: 1871—1952

William Seifriz

Botanical Laboratory, University of Pennsylvania, Philadelphia

WALTER T. SWINGLE was one of the most inspiring men who ever entered my life, and the lives of many others. Personally, I owe to him my first lesson in botany at the age of 7, my first job, in the Department of Agriculture, at the age of 17, and my first knowledge of the fact that science is more than experimentation.

David Fairchild recently reminded me of the little intellectual sanctuary which I claimed as my own, beneath the seminar table in my childhood home. There, ensconced, refusing to come out at my mother's command, I heard Dr. Swingle tell of the date palm which he hoped to introduce into America, and later did; of the Chinese trifoliate orange which he thought would be excellent stock for the grafting of the sweet orange, as it was; of the mangosteen, "fruit of the gods" he called it; and I took a solemn vow to taste of it, and 40 years later did so; of Java coffee, Egyptian cotton, and bacteria—for Swingle was as much a plant pathologist as he was a horticulturist. The discussions at the seminar table under which I sat had often to do with plant diseases, Merton White taking the side of the fungi and Erwin Smith holding out for the bacteria, the argument having to do with the cause of pear blight. "Willie," Dr. Swingle said to me, "every particle of dust in the air is covered with bacteria." Dr. Fairchild has said that he, too, first heard of bacteria from Dr. Swingle. The isolation of anthrax and immunity through inoculation had been accomplished only ten years previously by Pasteur. What, I am sure, was the first culture transfer room ever to be constructed in America was made by Swingle and Fairchild in 1890 at the Kansas State Agricultural College, where they were students together. It was an old piano box lined with cotton cloth soaked in a solution of corrosive sublimate. Into this supposedly septic box these two alternately crawled.

Among his many plant interests those of the orange and the date occupied most of Swingle's time. I recall with pleasure one citrus hybrid, the citrange, for I was then the only American boy who had had citrange-ade. The citrange was a cross between the sweet orange and the trifoliate orange. Better known is the hybrid between the tangerine and the grapefruit, which yielded the tangelo, now extensively grown in Florida. It should be remembered that in Swingle's earliest years the orange, date, and fig were mere names in America. In writing to Fairchild from Florida about 1892, Swingle described the orange tree as "something like an oak with bright yellow fruits hanging from its branches." Swingle's work on citrus not only took him on many long journeys in the Orient, but on another pleasant journey, that of marriage with Maude Kellerman, who had demonstrated the practicability of keeping pollen viable long enough to ship halfway around the world (before the days of air mail!), thus bridging the time between flowering periods of different species.

Swingle's work with the date and his treatise on date culture, which is a classic, have so overshadowed his other work that most of it is unknown except to his closest friends. His comparative studies in ecology in Algeria, Arizona, and California, and his introduction of the fig insect, *Blastophaga*, from Algeria into California, which made possible the successful culture of the Smyrna fig, are widely known, but who has heard of his interest in optics which resulted in his persuading Zeiss to make a lens of diamond based solely on Swingle's calculations? And who knows of his work in ultraviolet photography, in which I had a hand? He had me set up a complete equipment of which the cytologist, Yamaguchi, was to have charge, but Yamaguchi never got farther east than Chamberlain's laboratory in Chicago.

Swingle saw the applicability of every brand of science that would conceivably throw light on a bio-

logical problem. The mitotic figure in dividing cells he thought might be a magnetic field. Today we still recognize the superficial resemblance. And so he persuaded Lyman J. Briggs to join him in subjecting dividing animal eggs to a high electromagnetic field. Swingle had the rare quality of giving a research problem to others if he thought they would do it better. He sent me to work with Dr. Briggs so that the findings of Sir Oliver Lodge could be tested. Lodge claimed a great increase in yield from plants subjected to high-voltage static electricity. During three years we stimulated everything, but only Dr. Briggs and a government mule were visibly affected.

The amount of work that Swingle accomplished was phenomenal. One of his undertakings has resulted in the Library of Congress possessing the largest and richest collection of Chinese books outside the Orient. This one activity alone, involving the acquisition of over 100,000 volumes and the active participation of ambassadors, ministers, eminent orientalists, and the Empress Dowager of China, would have been a lifetime occupation for the average scholar but was merely incidental to Swingle's major work.

I presume the world at large will remember him because of his contributions to science and oriental literature, but for me he will always remain what the Germans call "ein grosser Geist"—greater than a scholar and more human than a genius. Swingle managed to convey not only the joy of scientific research but also the mental satisfaction to be derived from pure observation. As Swingle said many years ago, "Look and look again and again. Experiments are not necessary in order to learn, and experimental work without observation can leave one woefully ignorant."

He would not have studied the chromosome picture of a plant, or have cross-pollinated it, or isolated a protein from it, or have analyzed the soil where it grows, without first knowing the plant. He was the very antithesis of the "uneducated expert."

So brimful of ideas was he that at the Department of Agriculture it was said, "As long as Swingle is here, there will be no dearth of ideas." Though he was creative by nature, I believe his years in Europe helped for they made a lasting impression. He spent a year with Strassburger at Bonn in 1895 and a year

with Pfeffer at Leipzig in 1897. His association with Strassburger resulted in work at the Naples Marine Laboratory and the publication, with Strassburger, Fairchild, and others, of articles which filled an entire volume of Pringheim's *Jahrbücher für wissenschaftliche Botanik*. He never lost contact with European and North African laboratories and experimental stations.

Much is said these days about the integration of knowledge, and much is attempted in the way of international good will through mutual scientific interests. I have been associated with several such undertakings and have wondered if Swingle did not embody the qualities necessary for them to a greater degree than any two dozen men who have attempted to achieve them. He knew the meaning of intellectual good will. He was of an affectionate nature and felt deeply and warmly toward all people, and he often assumed their welfare to be a personal responsibility. To meet him was a delightful experience. He made you feel as if you were the only person in the world who mattered at the moment, and he meant it. His concern for others was often dramatic in its intensity. He once told me that, given the chance, he could save China from famine. He had developed a drought-resistant cereal, which, he said, would grow on upland Chinese deserts. The Department of Agriculture was often put to it to decide whether to hold Swingle's enthusiasm in check or let him have his way at the risk of a fiasco. Few things annoyed me more in connection with the Department than this check on him. For me he was the Department of Agriculture, and those who kept him in check are today unknown.

To be told when and where he was born, at Canaan, Pennsylvania, in 1871, and when and where he died, January 1952, in Washington, D. C., is of less importance than to know that he lived and inspired more agricultural botanists than any other one man. To have known him as a man and as a scientist was a great privilege. He was as kindly as he was brilliant. I never saw a photograph that did not show him with a smile and a little twinkle in his eye. It's good that he lived when he did, when the world of science needed men of his enthusiasm. The present Department of Agriculture and the world at large are foreign to his temperament. More callous characters than his are needed to cope with those forces which hold so many in check today.



News and Notes

Summer Conference on College Biology

THE Summer Conference on College Biology was held at the University of Oklahoma, June 15-19, under a grant from the National Science Foundation. More than 50 invited participants represented 32 colleges and universities from Oklahoma, Texas, Arkansas, Kansas, Missouri, Colorado, Arizona, Louisiana, and Illinois.

The conference was organized to discuss improvement and modernization of the content of introductory college biology courses on the premise that new research findings and concepts must be assimilated and integrated if such courses are to serve most effectively the purpose of biology in general and the needs of future professional scientists.

The conference sessions were organized about the common topic, "What are the materials from modern . . . (e.g., embryology) which should be included in introductory college biology courses? How are these materials related to, how do they contribute to, and how do they depend upon, comprehension of other fields?" The fields that were discussed were selected to present the broadest possible cross-section of biology and related disciplines.

The session speakers, chosen for their interest in introductory courses as well as in active research, were: embryology, J. H. Bodine, University of Iowa; physiology and biochemistry, Florence Moog, Washington University; biophysics, David Pomeroy, Army Medical Research Laboratory, Fort Knox; bacteriology, Orville Wyss, University of Texas; genetics and evolution, L. J. Stadler, University of Missouri; taxonomy, Joseph Ewan, Tulane University; histology, histochemistry, and cytochemistry, Howard C. Hopps, University of Oklahoma Medical School; and ecology, Charles E. Olmsted, University of Chicago.

The introductory address was made by Harry C. Kelly, Assistant Director for Scientific Personnel and Education, National Science Foundation. Ralph W. Gerard, University of Illinois Neuropsychiatric Institute, gave the major address of the conference. The concluding and summarizing paper was given by Paul R. David, University of Oklahoma.

The following paragraphs are largely abstracted from the paper read by Paul R. David and are given without attempt to credit the author or authors.

1. Biology, in general, is failing to attract the best students and, furthermore, is held in a position of low esteem by laymen. This may be due in part to introductory courses that present biology as a body of doctrine and not as a study of dynamic phenomena that have inherent within them the most fascinating and important problems of the universe.

2. Recognizing that biology courses are failing to meet the objectives set for them, there is need for serious re-evaluation of materials and organization of the courses. The facts that are presented need to be

selected carefully so that they will best illustrate causal relationships and thus present the dynamic or cause-and-effect viewpoint that is desired.

3. Although biology is compartmentalized into various fields, e.g., genetics, comparative anatomy, bacteriology, for convenience, these are artificial barriers. A real effort must be made to present living organisms as products of their evolution, heredity, physiology, anatomy, ecology, and behavior, if biology is not to be sadly and severely misrepresented.

4. There must be no separation of structure and function in the study of living organisms, but structure and function must be presented as inescapably dependent upon each other.

5. The use of a dynamic descriptive approach to biology will entail constant understanding and employment of the scientific method. From this will accrue an appreciation of the theoretical aspects of biology and a way of thinking that is an absolute requirement in our society today if our lives and our civilization are to be ruled by reason rather than by superstition, prejudice, or self-interest.

Although these five ideas have been stated many times before, their constant reiteration indicates that they have not yet been incorporated successfully into the majority of introductory college biology courses and that this incorporation is necessary if such courses are to fulfill their purpose.

Complete proceedings of the conference will be published.

HARRIET HARVEY

*Department of Zoological Sciences
The University of Oklahoma*

Scientists in the News

Emil Artin, mathematician, and Hadley Cantril, psychologist, have been appointed to two of Princeton University's oldest endowed chairs. Dr. Artin has been made Henry Burchard Fine Professor of Mathematics, and Dr. Cantril, Director of the Office of Opinion Research, is Stuart Professor of Psychology. Recently named Chairman of the Department, Dr. Cantril has had a major role in the development of a series of demonstrations in social psychology.

Pearce Bailey, Clinical Professor of Neurology at the Georgetown University School of Medicine, has been made President of the American League against Epilepsy. He succeeds Francis M. Forster, Dean of the Georgetown medical school.

Stanley S. Ballard, Professor and Chairman of the Department of Physics at Tufts College, has been granted a leave of absence for the coming academic year. He will spend this period as a member of the Electronics Division of the Rand Corporation, Santa Monica, Calif.

Jorgen M. Birkeland, Professor and Chairman of the Department of Bacteriology at Ohio State University, has been given a leave of absence to serve as Science Attaché in the American Embassy at Stockholm. This assignment represents further progress in carrying out the recommendations of the report, *Science and Foreign Relations*, adopted by the State Department in 1940. Included in that report was a proposal for the establishment of an Office of Science Advisor in the State Department and of science attaché posts in important American missions abroad. Dr. Birkeland will replace **Harald H. Nielsen**, Ohio State University physicist who will return to his university this autumn.

M. C. Brockmann, formerly senior scientist for Kingan & Co., Indianapolis, has been appointed Director of Research.

Louis Costrell, who has been associated with the National Bureau of Standards since 1946, has been appointed Chief of the Nucleonic Instrumentation Section.

Hiden T. Cox, formerly Associate Professor of Botany at the Virginia Polytechnic Institute, has been appointed to the newly created post of Deputy Executive Director of the American Institute of Biological Sciences, Washington, D. C. On the faculty of the Institute since 1949, he has also taught at Howard College, Agnes Scott College, and the Mountain Lake Biological Station of the University of Virginia. As Head of the Botany Section of the Department of Biology at V.P.I., Dr. Cox has added administrative experience to his background of teaching and research.

Robert Davies, formerly an Associate Engineer with the Rand Corporation, Santa Monica, is Senior Research Engineer at the General Motors Research Laboratories, Detroit.

Victor H. Dropkin, formerly of the Naval Medical Research Institute, has been appointed Associate Nematologist in the Division of Nematology Investigations, Bureau of Plant Industry, Soils, and Agricultural Engineering. His first assignment is at Beltsville, Md.

Nicholas D. Duffett has recently been appointed Director of Public Health Laboratories of the St. Louis Health Department. Dr. Duffett has been with the Laboratory Section since 1944, first as Principal Bacteriologist and since 1948 as Assistant Director. He succeeds the late **Joseph C. Willett** who established the public health laboratory 32 years ago.

R. L. Ely, recently of the U. S. Air Force, is an engineer at The Johns Hopkins University Applied Physics Laboratory, Silver Spring, Md.

William L. Everitt, Dean of the College of Engineering, University of Illinois, is the recipient of the Institute of Radio Engineers' Medal of Honor for 1954, the highest technical award of the radio engi-

neering profession. The Institute gave the award "for his distinguished career as author, educator, and scientist; for his contributions in establishing electronics and communications as a major branch of electrical engineering; for his unselfish service to his country; for his leadership in the affairs of the Institute of Radio Engineers."

Carlos Luis Gonzalez, Director of Public Health of Venezuela, has been appointed Chief of the Division of Public Health, Pan American Sanitary Bureau, Regional Office, World Health Organization, Washington, D. C.

H. E. H. Greenleaf, Professor of Mathematics, DePauw University, has been made Head of the Department of Mathematics.

Edward G. High has resigned from the staff of the Department of Chemistry at Prairie View A. & M. College, Prairie View, Tex., to accept the position of Associate Professor of Biochemistry at Meharry Medical College, Nashville, Tenn.

Klaus Hofmann, formerly Research Professor of Chemistry, has been appointed Professor of Biochemistry and Chairman of the Biochemistry Department in the School of Medicine, University of Pittsburgh.

Paul L. Salzberg, Assistant Director of the Chemical Department of the Du Pont Company, Wilmington, has been made Director. He succeeds **Cole Coolidge**, who died recently.

Ralph E. Snyder, Assistant Dean of New York Medical College since 1951, has been appointed Executive Dean. He succeeds **J. A. W. Hetrick**, who will continue as President of the college.

George Dinsmore Stoddard, psychologist and President of the University of Illinois has resigned, effective August 31st, as the result of a 6 to 3 vote of "no confidence" by the university's board of trustees. Harold E. Grange, Illinois football star of the 1920's, was the board member who asked for the confidence vote. Twenty department heads, and two professors acting in the absence of their superiors, joined together in condemning the action of the board. They issued a statement in the form of a letter addressed to Dr. Stoddard and to Coleman R. Griffith, university provost who also received a no confidence vote. The group thanked Dr. Stoddard for his "stand for honesty in science and integrity in education" and described him as "a man of progressive programs and ideas." The letter went on to say, "Always we have had freedom to speak our opinions without fear and without intimidation," and further added: "We wish also to tell you that we consider the action of the trustees in forcing your resignation contrary to all accepted standards of academic procedure. Technically legal, it is morally unjust."

Gov. William G. Stratford was asked if he could

state specifically what disagreements led to the decision by the board of trustees. He replied: "There was a series of incidents over a period of years. It was getting to be a difficult picture there at the university, and it apparently was felt by the board of trustees that it would be better to have a president with whom it had a better working relationship. There was a feeling on the part of the board that it would be better to have someone less controversial toward the Legislature and the public. The Board sets the policy for the university. The trustees have felt that Dr. Stoddard was attempting to originate policy, instead of its coming from them."

Park Livingston, chairman of the board of trustees, listed 14 charges against Dr. Stoddard on which the board had based its vote. In response, Dr. Stoddard issued a point by point rebuttal, defending his action in every case and terming some of the charges completely false.

The most acutely controversial issue was that concerning Krebiozen. Andrew C. Ivy, Vice President of the university and Head of the Department of Clinical Science, had been conducting research on and promoting the application of a new secret drug known as Krebiozen, which was said to have curative properties in the treatment of cancer. Failure to disclose the nature of the drug led to Dr. Ivy's suspension from the Chicago Medical Society. The American Medical Association reported unfavorably on Krebiozen, as did the American Cancer Society. Dr. Stoddard banned further research with the material and arranged that Dr. Ivy take a leave of absence.

In his official statement concerning Dr. Stoddard's resignation, Mr. Livingston stressed that the resignation had not resulted from the issue between Dr. Stoddard and Dr. Ivy. Dr. Ivy has since returned to his post as Head of the Department of Clinical Science and has been named Distinguished Professor of Physiology. He has resumed his work with Krebiozen.

Before assuming the presidency of Illinois in 1946, Dr. Stoddard was N. Y. State Commissioner of Education and President of the University of the State of New York. In recent years he has participated in many significant educational activities. He was chairman of the U. S. Education Mission to Japan which overhauled the Japanese school system, and he has been chairman of the American Council on Education as well as a member of the President's Commission on Higher Education. He was a leader in the formation of the United Nations Educational, Scientific and Cultural Organization, with which he has been associated in various capacities, including that of U. S. member of the executive board. He was a delegate to the UNESCO conferences in the years 1946-1948.

Education

The Chemical Education Committee of the Philadelphia Section of the American Chemical Society will present two Continuation Courses, "Pharmacology

of the Nervous System" and "The Objective Specification of Color and Color Differences," during the fall. Detailed information may be obtained from Dr. E. R. Nixon, Harrison Laboratory, University of Pennsylvania, Philadelphia 4, Pa.

The American Society for Metals has just completed the second Metals Technology teacher training course at Fitchburg, Mass. The State of Massachusetts, working in cooperation with the ASM, is the second state to offer a course in Metals Technology for vocational and technical high school teachers. The first training course of this type was completed in June at Oswego State Teachers College, Oswego, N.Y. Twenty-eight men out of the 41 teachers who attended the Fitchburg session sought credit for professional development and took formal examination after completing the course.

The Department of Mathematics, DePaul University, Chicago, is inaugurating a new program of studies in mathematics intermediate to the Master's degree and the Ph.D. degree. Students completing this program of study will be granted a certificate designating them as Mathematics Specialists. Requirements include 48 semester hours of graduate work in mathematics, a reading knowledge of French, German, or Italian, a comprehensive written examination, and the completion of an oral examination.

The former Kaiser Wilhelm Institutes and Research Centers which, after 1945, had been organized within the Deutsche Forschungshochschule Berlin-Dahlem, have become part of the Max-Planck-Gesellschaft under the name of Max-Planck-Institute und Forschungsstellen. The Deutsche Forschungshochschule has been dissolved.

The series of basic courses in the techniques of using radiosotopes in research continues to be offered at regular intervals by the Special Training Division of the Oak Ridge Institute of Nuclear Studies. Starting dates of the next three courses are January 4, February 8, and March 15, 1954. Applications and supporting letters must be received *three months* in advance of the starting date.

The courses are offered to enable mature research personnel to obtain in a short time (4 weeks) sufficient facility in the use of radiosotopes to apply them safely and efficiently to their own research problems. Since the demand for this type of training exceeds the facilities for supplying it, the course is designed for university faculty members, group leaders of research teams, and other individuals who will impart the training to additional persons. Applications and additional information may be obtained from the Special Training Division, Oak Ridge Institute of Nuclear Studies, P. O. Box 117, Oak Ridge, Tenn.

St. John's University, Brooklyn, has announced the extension of the curriculum of the Department of Biology to permit study for the Ph.D. degree. Six new courses have been added to the department to

provide the necessary extra course material for doctoral candidates. The new doctoral program is open to qualified students in the fields of physiology, parasitology, and zoology.

Within 3 to 5 years the Stanford University Medical School will be moved from San Francisco to more adequate quarters in Palo Alto.

The University of Hawaii has recently authorized its Botany Department to offer a course of studies leading to the Ph.D. degree. Instructors for the program will be H. St. John, M. L. Lohman, E. J. Britten, M. S. Doty, B. J. Cooil, and K. Shoji.

New four-year undergraduate programs leading to the B.S. degree in fisheries technology and in food management will be set up at the University of Massachusetts this fall. Both curricula will be administered by the Food Technology Department, headed by Carl R. Fellers. The food management course will be separate from a two-year non-degree course now offered by the same department.

The fisheries technology program is being offered in response to urging by civic, industrial, and educational agencies in New England seaboard cities. At present, the only fisheries school in the U. S. is located on the west coast at the University of Washington.

Grants and Fellowships

The Beckman Award, an award honoring U.S. and Canadian scientists for work in chemical instrumentation, has been established by Arnold O. Beckman, Beckman Instruments, Inc., South Pasadena, Calif. To be presented first in the spring of 1955, the \$1,000 annual prize will recognize outstanding achievements in the development of new instruments for chemical analysis and the application of instruments to chemical process measurement and control.

Administered by the American Chemical Society, the Beckman Award will give special consideration to originality as well as the value of the contribution in reducing manufacturing costs or improving product quality. Purpose of the award is twofold: to stimulate research in analytical instrumentation, and to encourage development of instrumental methods for measuring and controlling chemical processes.

Four research bacteriologists who carried on a ten-year search for a series of new antibiotics known as the Pyos (*Pseudomonas aeruginosa*) have received the 1952 Commercial Solvents Award in Antibiotics. The award, which consists of a gold medal, \$1,000, and engraved scrolls, was presented to Ibert C. Wells, Syracuse, N. Y.; Edwin E. Hays, Chicago, Ill.; E. A. Doisy, St. Louis, Mo.; and William L. Gaby, Philadelphia, Pa. The group was selected for the honor by the Commercial Solvents Award Committee of the Society of American Bacteriologists for research started at St. Louis University in the early days of World War II.

Their work was begun prior to 1945, in which year their first publication appeared, and reached its fruition with the proof of structures in 1952. These workers have demonstrated that, in addition to pyocyanine, one of the earliest known antibiotics, *Pseudomonas aeruginosa* produces several other antibacterial agents; they have worked out methods of isolation, separation, and purification of these agents, defined their physical and chemical properties, proposed structural formulae for them and, by degradation and synthesis, proved the acceptability of the proposed formulae.

The Committee on International Exchange of Persons, Conference Board of Associated Research Councils, 2101 Constitution Avenue, N.W., Washington, D. C., has announced the 1954-55 Fulbright Awards for university lecturing and advanced research in Europe, the Near East, Japan, and Pakistan. Application forms are obtainable only upon individual request to the Conference Board Committee, and completed forms should be returned to the Committee. All persons requesting application forms are provided with a copy of the booklet, "U.S. Government Awards under the Fulbright Act," which contains detailed information on terms of awards, eligibility, and application and selection procedures. *The closing date for making application for any of the programs listed is October 15, 1953.*

The Heineman Foundation for Research, Educational, Charitable and Scientific Purposes, Inc. has announced the establishment of the Dannie Heineman Prize. This prize of \$5,000 is to be awarded every 3 years to the author of an outstanding book or manuscript in the mathematical or physical sciences. The object of the prize is to encourage the writing of books on a high scientific level which have merits of exposition and which are likely to facilitate access to important fields of research. Submissions for the next award must be made *not later than Dec. 31, 1955*. Further information may be obtained from the Secretary of the Foundation, 50 Broadway, New York 4.

Announcement has been made of the Louis Lipsky Exchange Fellowships in the Natural Sciences. These fellowships are intended to promote fundamental research in the natural sciences at the Weizmann Institute of Science at Rehovoth, Israel. They are awarded as a rule to persons who will have met all of the requirements for the doctor's degree before assuming their fellowships.

The basic stipend is \$3,600 per annum, plus travel to the place of study. Larger stipends will be granted to senior investigators. Appointments are for one year. In special cases appointments can be made for a lesser period. *The closing date for receipt of applications for 1954-1955 will be Oct. 15, 1953.* Awards will be made about December 1, 1953. Detailed information may be obtained from Dr. D. Rittenberg, College of Physicians and Surgeons, 630 W. 168 St., New York 32, N. Y.

Meetings and Elections

The largest meeting of surgeons in the world, the 39th Annual Clinical Congress of the American College of Surgeons, will be held in Chicago, Oct. 5-9. More than 11,000 surgeons, physicians, and others will attend to participate in postgraduate courses, forums, symposia, panel discussions, color television programs, medical motion pictures, ciné clinics, and exhibits, all concerned with developments in surgery.

The American Institute of Nutrition, a new affiliate of the AAAS, was provisionally incorporated on Sept. 27, 1928, and officially organized on April 10, 1933, as an educational institution for the dissemination of scientific knowledge regarding the chemistry and physiology of nutrition and for promoting research in the field of nutrition. The Institute sponsors the monthly publication, the *Journal of Nutrition*. The present membership totals 410. The following officers have been elected for 1953-54: pres., Conrad A. Elvehjem, University of Wisconsin; v. pres., George R. Cowgill, Yale University; sec., James M. Orten, Wayne University College of Medicine; treas., O. L. Kline, U.S. Food and Drug Administration, Washington, D. C. Representatives to the AAAS Council are Joseph H. Roe, George Washington University School of Medicine, Washington, D. C., and Fredrick J. Stare, Harvard School of Public Health.

News of latest developments aimed at preventing disease and promoting personal and public health will be exchanged by professional workers from all parts of the free world at the 81st annual meeting of the American Public Health Association and annual sessions of 40 related organizations at the Hotels Statler and New Yorker, New York City, November 9-13. More than 5,000 public health workers—physicians, dentists, nurses, engineers, statisticians, veterinarians, sanitarians, nutritionists, health educators, entomologists, biologists and others—are expected to attend the sessions. Theme of the meetings will be "Meeting the Health Needs of the Community."

The Association of Official Seed Analysts has elected the following officers for 1953-54: pres., Duane Isely, Iowa State College; v. pres., Buford Jones, State Seed Laboratory, State Dept. of Agriculture, Oklahoma City; sec.-treas., R. G. Colborn, Nebraska Dept. of Agriculture, Lincoln, Neb.

The Southwestern Association of Naturalists was formed at an organizational meeting attended by 52 persons at the University of Oklahoma Biological Station at Lake Texoma on May 23, 1953. As stated in the constitution, "The object of the Association shall be to promote the field study of plants and animals, living and fossil, in the Southwestern United States and Mexico, and to aid the scientific activities of its members." SWAN hopes to stimulate the study of the region by bringing together persons of like interests through publication of annotated member-

ship lists, annual meetings, and perhaps later through the publication of a journal.

The officers elected for the first year were: pres., W. Frank Blair (Vertebrate Zoology), University of Texas; v. pres., George J. Goodman (Plant Taxonomy), University of Oklahoma; and sec.-treas., Herndon G. Dowling (Herpetology), University of Arkansas. The geographic scope of the Association at present includes Mexico and the states of Arizona, Arkansas, Kansas, Louisiana, New Mexico, Oklahoma, and Texas. Persons interested in the natural history of this region are invited to join the Association. Membership blanks may be obtained from any of the officers.

Miscellaneous

The Bureau of Medicine and Surgery, Department of the Navy, Washington, D. C., has begun limited distribution of a 235-page volume listing names and activities of medical department personnel in World War II who became casualties or who were decorated.

The Mental Health Bell, a bell cast from shackles once used to restrain mental patients, has been awarded to the Baltimore Sunpapers for their "outstanding service in the fight against mental illness." The award was made by George S. Stevenson, Medical Director of the National Association for Mental Health, Inc. The bell will be kept on display until Mental Health Week, 1954, when it will be presented to the newspaper, magazine, radio or television chain or station which will have done most to advance mental health in the preceding year. The award to the Sunpapers was based on their five-year crusade for improvement of Maryland's mental hospitals, which resulted in the operating budget being tripled and \$20,000,000 being appropriated for hospital construction.

The National Issues Committee, whose organization was announced recently by Mrs. Eleanor Roosevelt, will work for progressive national health legislation, among other objectives.

A group of scientists left recently for the North Geomagnetic Pole, where they will make a comprehensive series of high altitude observations of the primary cosmic radiation in northern latitudes. In addition they will also study the temperature and density of the atmosphere at extreme altitudes. Named "Project Mushrat," the expedition is sponsored by the Bureau of Aeronautics, the Office of Naval Research, and the Atomic Energy Commission. Instruments will be carried above 100,000 feet by balloon-launched "Deacon" rockets, which during a similar expedition last year climbed to a peak altitude of 295,000 feet. Participating in the research project are scientists, chiefly physicists, from the Office of Naval Research, the State University of Iowa, New York University, and the Aeronautical Research Laboratories, General Mills, Inc., Minneapolis.

Technical Papers

Preliminary Observations on Intraspecific Variation of the Levels of Total Protein in the Sera of Some Decapod Crustacea¹

Charles A. Leone

Department of Zoology,
University of Kansas, Lawrence

The total protein found in the sera of decapod Crustacea may vary from 0.5 g % in one species to 8 g % in another (1-3). Little information is available on the variation which may normally occur within a single species. Values among individuals of the same species that differ by as much as 3 g % have been reported (3-5). Since hemocyanins constitute virtually all the protein in crustacean sera (6-8), a recent paper (9) listing a broad range of values for the content of copper in the blood of the Australian marine crayfish, *Panulirus longipes* Milne-Edwards, might indicate that widely variable amounts of total protein could likewise be expected to occur.

TABLE 1
NORMAL RANGE OF TOTAL PROTEIN IN THE SERA OF DECAPOD CRUSTACEA

Species	Common name	No. of individuals	Range g/100 ml	Mean g/100 ml
Crustacea				
<i>Callinectes sapidus</i>				
Rathbun	Blue crab	31	1.83-12.00	4.39
<i>Cancer magister</i>				
Dana	Edible crab	26	1.16-13.75	4.45
<i>Cancer irroratus</i>				
Say	Rock crab	10	1.75-11.45	5.39
<i>Libinia emarginata</i>				
Leach	Spider crab	12	0.73-7.25	4.14
<i>Homarus americanus</i> Milne-Edwards	Lobster	9	2.20-10.20	4.28
Arachnida				
<i>Limulus polyphemus</i> Linnaeus	King crab	28	0.77-13.45	5.92

Table 1 presents data on the total protein in the sera of several species of decapod Crustacea and one species of Arachnida. The range for each species is remarkable. *Cancer magister*, for example, has values which extend from 1.16 to 13.75 g %. This is a considerably wider range than has been previously re-

¹ Aided by a contract between the Office of Naval Research, Department of the Navy and Nonr 58303.

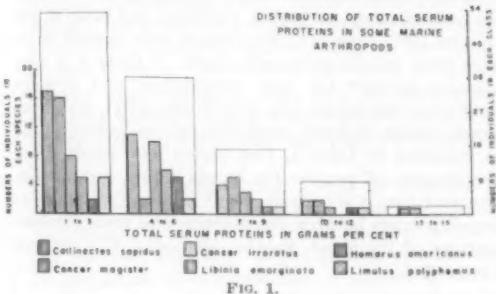


FIG. 1.

ported for a single species; it also exceeds the cited ranges of values among different species. From the information in the table it appears that broad ranges are normal for species of decapod Crustacea and the marine arachnid *Limulus* (= *Xiphosura*) *polyphemus*. In general, the localities from which each species was collected were quite restricted and the number of individuals listed can properly be regarded as part of a single population for that species. *Limulus* is an exception in that these individuals were assembled from three widely separated localities (Massachusetts, New Jersey, and North Carolina). The small numbers of individuals listed for *Cancer irratus*, *Libinia*, and *Homarus* were necessary in order to be reasonably sure that a single population was represented for each of these species. The ranges for these three species increased when the values (not included in the table) for the total protein from individuals collected at different times and other localities were added to the numbers representing the species. The sizes of the individuals within each species were variable, but no immature or small organisms were included in the comparisons. It is my conviction that the wide range of values presented for each species in Table 1 may normally be expected to occur in a natural population, at any given time.

The arrangement of the values for the total serum proteins for each species is not a normal frequency distribution. An evaluation of the collective data reveals a continuous distribution over the entire range. By arbitrarily establishing class values of 2 ± 0.5 g % of protein, and by classifying all the individuals accordingly, the class of lowest values, $1-3 \pm 0.5$ g %, includes the most individuals and the class of highest values, $13-15 \pm 0.5$ g % has the least (Fig. 1).

The amount of protein in the sera of the brachyurans *Cancer magister* and *Callinectes sapidus* appears to be crudely correlated with the stages of the molting process. Papershell crabs generally had the lower values; thin hardshell crabs had the middle values; thick hardshell and peelers had the highest values. The level of the total protein in the sera of softshell crabs was more variable than for the other

kinds of crabs. Observations similar to these were not made for the other species. More precise studies are indicated.

Much physiological data pertaining to the concentrations of inorganic ions in the blood and body fluids of Crustacea have been established from pooled samples from two or more individuals. If there is a correlation between the ionic composition and protein content of the blood (2), and if the latter varies as much, under uniform conditions of environment, as is indicated in Table 1, then errors may result from the practice of pooling the bloods before making determinations. It is entirely possible, also, that no relationship exists between the proteins and ionic concentrations of the blood. Further studies on this subject are needed.

References

1. FLORKIN, M., and BLUM, H. F. *Arch. intern. physiol.*, **38**, 353 (1934).
2. PROSSER, C. L. (Ed.). *Comparative Animal Physiology*. Philadelphia: Saunders, 104 (1950).
3. PAYOR, C. W., and LEONE, C. A. *Biol. Bull.*, **103**, 433 (1952).
4. DRILHON-COUTOIS, A. *Ann. J. Physiol.*, **10**, 377 (1934).
5. WEBB, D. A. *Proc. Roy. Soc. (London)*, **B129**, 107 (1940).
6. ALLISON, J. B., and COLE, W. H. *J. Biol. Chem.*, **135**, 259 (1940).
7. CLARK, E., and BURNET, F. M. *Australian J. Exptl. Biol. Med. Sci.*, **20**, 89 (1942).
8. TYLER, A., and SCHEER, B. T. *Biol. Bull.*, **83**, 193 (1945).
9. BECK, A. B., and SHEARD, K. *Australian J. Exptl. Biol. Med. Sci.*, **27**, 308 (1949).

Manuscript received May 8, 1953.

Occlusion of Copper and Zinc by Some Soil Materials of Lower Mississippi River Area¹

V. P. Sokoloff

The Johns Hopkins University, Baltimore, Maryland

This preliminary note reporting a selective occlusion of small amounts of copper and zinc by some Mississippi River materials and by some soils derived from them is a part of a detailed report now in preparation. Observations on the occlusion of copper and zinc are parts of a general study of geochemistry of archaeological sites. The study itself was undertaken as a search for the means, the methodology, whereby the knowledge of weathering phenomena could be brought to bear on archaeological-anthropological problems, specifically, on the physical-chemical history of archaeological terrains.

Field indications and experimental evidence suggest existence of mechanisms in soil materials, soils, and parts of some soil profiles that are capable of occluding rather than exchanging very small amounts of copper and zinc, singly or in the presence of each other, under certain conditions. Such mechanisms exist

¹The studies here reported were made possible by two grants-in-aid from the Wenner Gren Foundation for Anthropological Research. This generous aid is most gratefully acknowledged.

in some but not in all of the materials examined. Their presence or absence may be correlated with origin and extent of weathering of the materials or horizons. The number of comparisons made so far is only 75 and, obviously, far more work is needed to ascertain the correlations and to identify the occluding mechanisms. The results obtained to date are so consistent, however, and the test employed is so simple and clearcut, that a preliminary note here presented appears to be permissible and, indeed, desirable.

A soil material shaken with a solution containing as much as 20 ppm Cu or Zn, singly or in the presence of each other, at the terminal pH from 5 to 8, responds generally in one of the following three ways: (a) both Cu and Zn are withdrawn from the aqueous phase quantitatively, (b) Cu is withdrawn but Zn is not, or (c) neither Cu nor Zn is withdrawn.

Reactions (a) and (b) take place at ordinary temperatures, seem to be instantaneous, and are reversible on the acid side of pH 2. They are not influenced by Ca^{++} , Mg^{++} , Na^+ , Fe^{+++} , Cl^- , SO_4^{2-} , HCO_3^- , CO_3^{2-} , or NO_3^- , but are inhibited by citrate and, to a lesser extent, by tartrate and acetate. They are not affected by enriched bacterial or yeast growth on added sucrose or by the enrichment of denitrifying microorganisms. The occluding mechanisms are not impaired by prolonged heating of the soils in question at 300–400° and appear to be associated with the mineral rather than with the organic fraction of soils. The organic chelators or fixers of Cu and Zn were encountered only in some humous topsoil horizons but their study is outside the scope of this note.

The occlusion of Cu and Zn, in the amounts studied, is independent of their calcium carbonate content, or of the proportions of acid-soluble iron and possibly the entire iron group.²

Cu is occluded on the alkaline side of pH 4, and Zn on the alkaline side of pH 5.5 or so. The occlusion does not take place on the acid side of these ranges. On the alkaline side of about pH 8, the occlusion is obscured by other phenomena. Occluded Cu and Zn can be recovered quantitatively at pH 2, as a rule, and in still more acid solutions.

Soil materials that do not occlude Cu or Zn appear to be more kaolinized, on the whole, than the occluders of both Cu and Zn. However, a detailed study of the occluding factors still remains to be carried out, and it is not clear yet whether the factors or the surfaces in question are associated with certain series or species of the clay minerals. They may prove to be associated with simpler substances of colloidal dimensions, judging by the responses of some sands. The author regrets the unavailability of laboratory facilities for further work in this connection.

The only seemingly positive correlation between the occlusion response and the kind of occluding material

²Freshly precipitated Fe(OH)_3 occludes both Cu and Zn on the alkaline side of pH 4. Amounts of occluded or coprecipitated Cu and Zn increase at pH 5, 6, 7, and 8, under comparable conditions. Zn is occluded by Fe(OH)_3 more readily than Cu. CaCO_3 added to lime-free nonoccluding materials seems to have no effect on the occlusion.

TABLE 1

OOCCLUSION RESPONSE AND EXTRACTABLE COPPER AND ZINC IN LOUISIANA-MISSISSIPPI SOIL MATERIALS*

Occlusion response	Per cent of materials examined	Extractable Cu, ppm		Extractable Zn, ppm	
		Range	Average	Range	Average
a. Both Cu and Zn occluded in presence of each other	15	0-150	19	11-150	59
b. Cu occluded in presence of Zn; Zn not occluded in presence or in absence of Cu	40†	0-7	1	1-63	13
c. Neither Cu nor Zn occluded singly or in presence of each other	45	0-1	0.2	0-24	4

* The occlusion test consists of the following operations: (a) 50 g of air-dry soil shaken in a 200-ml-stoppered bottle with 100 ml of a solution containing 20 ppm Cu^{++} and 20 ppm Zn^{++} in 0.01 N HCl and allowed to settle; (b) supernatant liquid is withdrawn, filtered, if necessary, and tested for Cu^{++} and Zn^{++} by the dithizone method. pH of the system is maintained between 5 and 7.5 by HCl or NH_4OH . The appropriate blanks are run concurrently. With soils occluding both Cu^{++} and Zn^{++} , the blanks are scarcely required. Such soils, in fact, can be used to remove traces of the two metals from distilled water and reagents, including ammonia.

† One-fifth of these materials showed a small or a doubtful capacity to occlude Zn.

is shown in Table 1, and is as follows. The greater the amounts of HCl-extractable Cu and Zn in the soil, the more likely is the soil to occlude additional small amounts of Cu and Zn. This crude generalization suggests merely presence or absence of certain mechanisms responsible for the reaction. Quantitative studies of a "Cu-Zn capacity" or some such possible characterization of our materials are deferred. Empirically, however, the test has already shown some value in the field, as may be illustrated by a summary of Table 1.

In this table, materials believed to be representative of the area studied are grouped in three categories: (a) Occluders of both Cu and Zn, singly and in the presence of each other. These materials include freshly deposited Mississippi River sediments, some midden soils near Sicily Island, Louisiana, buried middens in the delta south of New Orleans, deeper horizons of natural levees at Mauvais Bois, Point au Chien, and Carlyle, La. Their texture ranges from silty sand to clay and their calcium carbonate content is highly variable. (b) Occluders of Cu but not of Zn. This prominent group contains mature loess profiles, to 100 in. depth or so, near Natchez, Miss., leached and unleached loess near Doloroso, Miss., some artificial levee horizons (in place for 75 years or so), and some topsoil horizons from Poverty Mound, in the Arkansas River area. Their texture and CaCO_3 range are like

those in the preceding group. (c) Occluders of neither Cu nor Zn. This most numerous group includes soil profiles on Red River deposits, degraded loess, "brown loam" soils on the older Pleistocene Mississippi River terrace, mature soils on the Prairie terrace (late Pleistocene), the lower Atchafayalla backswamp clay, materials from Teche I channel, most of the Poverty Mound Traverse, leached clays near Sicily Island, La., profiles near Marksville, La., both on made ground and natural buried soil, and senile soils on early Pleistocene and pre-Pleistocene materials throughout the area.

It may be possible to make use of the occlusion test in the identification of sediments in areas where geomorphologic-geologic data alone are insufficient for the purpose, especially in the Recent geologic areas in the delta. This possibility, if sustained, may be realized right in the field. All equipment and reagents for the test are easily portable and the test itself requires only a few minutes. It is my hope to ascertain further validity of the test in the coming season, all other things being favorable.

A tentative view of the significance of the observations here stated may be as follows. The Cu-Zn occluding mechanisms are very common in Recent materials of Mississippi River origin but not in the Red River sediments and, perhaps, not in the Arkansas River sediments. These mechanisms may deteriorate when the sediments containing them are exposed to sub-aerial pedogenesis. The zinc-occluding mechanisms tend to deteriorate and disappear, in the Recent, far more rapidly than the copper-occluding mechanisms. Loessification of sediments tends either to conserve or to produce the copper-occluding mechanisms.

Manuscript received May 6, 1953.

Some Observations on the Pathogenicity of Isoniazid-Resistant Variants of Tuberle Bacilli¹

Gardner Middlebrook and Maurice L. Cohn

Department of Research and Laboratories,
National Jewish Hospital at Denver and the
University of Colorado School of Medicine, Denver

It has been demonstrated (1) that the incidence of variants of tubercle bacilli resistant to isoniazid (INH) is even higher than is the case with streptomycin—a most disappointing observation in terms of what one could predict at that time concerning its usefulness in the treatment of tuberculosis. Since then we have had the opportunity of investigating more intensively the properties of these INH-resistant mutants both in the experimental laboratory and in the clinic.

The Vallée strain (bovine) and the H37Rv strain (human) were exposed to isoniazid on the oleic acid

¹ Presented before the Colorado Trudeau Society April 18, 1953.

TABLE I
PATHOGENICITY OF TUBERCLE BACILLI IN SPUTUM CONCENTRATES FROM PATIENTS TREATED WITH INH FOR AT LEAST 2 MONTHS

No. of Cases	Culture results		Pathogenicity for normal guinea pigs
	Primary isolation	Subcultures from animals	
4	S INH < 1 µg/ml OA+; ATS+	S INH < 1 µg/ml	Typical generalized visceral tuberculosis
9	R INH > 1 µg/ml OA+; ATS+	R INH > 10 µg/ml (2 cases) R INH > 1 µg/ml (5 cases) Partially sensitive to 1 µg INH/ml (2 cases)	Local abscesses; enlarged lymph nodes; smears positive for AFB
5	R INH (not known) OA-; ATS+	Negative cultures from abscesses and spleens	Local abscesses; enlarged lymph nodes; smears positive for AFB
3	R INH (not known) OA-; ATS±	Negative cultures from abscesses and spleens	Local abscesses; normal to slightly enlarged lymph nodes; smears positive for AFB

Note. S, sensitive; R, resistant; OA, unmodified oleic acid albumin agar medium; ATS, American Trudeau Society egg yolk potato medium; +, growth; -, no growth; ±, growth rare or absent; AFB, acid-fast bacilli.

albumin solid medium (OA medium), and variants, each resistant to 10 µg of INH/ml of medium, were isolated and subcultured through three passages in medium containing 10 µg of INH/ml. Then these organisms were tested for their pathogenicity by injection into each of two normal guinea pigs intravenously in a dose of 1 cc of undiluted Tween-albumin culture. The parent isoniazid-sensitive strains of H37Rv and Vallée were also used at the same time to infect each of two guinea pigs with the same numbers of living bacterial cells. The two guinea pigs injected with the isoniazid-sensitive Vallée strain died, as expected, at 12 and 19 days after infection. The companion animals infected with the strain resistant to more than 10 µg of INH/ml survived for 33 and 43 days respectively; the animal surviving for 33 days died of an unknown cause and with only minimal evidence of active tuberculosis; very few acid-fast rods were visible in a stained smear of its lungs. The animal which died on the 43rd day after infection probably died of tuberculosis, although there is no doubt that this isoniazid-resistant bovine strain had suffered striking loss of pathogenicity. The two guinea pigs injected with the INH-sensitive H37Rv strain died on 19 and 25 days respectively, of extensive tuberculosis. Yet, their companions infected with the INH-resistant H37Rv strain are still living now at 60 days. Thus, the INH-resistant Vallée strain was at least partially attenuated compared with its parent INH-sensitive strain, whereas the INH-resistant H37Rv strain is revealed to be markedly attenuated, if not completely avirulent, when compared with the parent INH-sensitive H37Rv strain. These experiments indicated that these strains of tubercle bacilli may become partially or completely attenuated for the guinea pig when they become resistant to 10 µg of INH/ml of OA or Tween-albumin liquid medium, under experimental laboratory conditions.

Studies have subsequently been made on tubercle

bacilli freshly isolated from patients treated for at least 2 months with INH alone or INH plus streptomycin and other chemotherapeutic agents.

Eleven different strains resistant to at least 1 µg of INH/ml of OA medium were isolated from as many patients. These strains were first isolated on medium containing 1 µg of INH/ml and then subcultured only once or twice in Tween-albumin liquid medium without INH and used to infect guinea pigs; two guinea pigs were injected intravenously with 1 cc of fully grown undiluted Tween-albumin culture. Subcultures were made from the lungs and spleens of animals that died in less than 60 days after injection, and on all animals that were still surviving and were, therefore, sacrificed at 60 days. The organisms so isolated were tested for their resistance to 1 and 10 µg of INH/ml, and, in some cases, to higher concentrations of INH. Three of these strains proved to consist exclusively of populations completely resistant to 10 µg of INH/ml of OA medium; and the guinea pigs infected with these strains survived for 60 days. At necropsy no evidence of tuberculosis was discovered in these guinea pigs. Seven of these strains consisted of populations resistant to 1 µg, but partially or completely sensitive to 10 µg of INH/ml; all guinea pigs infected with these strains died within 60 days after challenge. One strain proved to be sensitive to 1 µg of INH/ml; and the guinea pigs infected with this strain died at 17 and 27 days of generalized tuberculosis. The results of this preliminary survey have led us to the conclusion that resistance of human type tubercle bacilli to 1 µg of INH/ml of medium is not always associated with a significant degree of attenuation, but that, on the other hand, resistance to 10 µg or more of INH/ml of OA medium may be accompanied by marked loss of pathogenicity for normal guinea pigs.

In addition to these observations, carried out under relatively controlled conditions, we have made the following observations with primary sputum concentrates

from patients who had previously been treated with INH for at least 2 months. Twenty-one sputum concentrates, all of which were positive on smear for acid-fast rods, were inoculated onto American Trudeau Society egg medium, onto OA medium, and into guinea pigs, two guinea pigs for each specimen. These injections were made into the groin by the classical method. Table 1 summarizes the results obtained from the study of these 21 sputum concentrates. It will be noted that 4 of these strains proved to be pathogenic, growing on both the OA and the ATS media and causing extensive visceral tuberculosis within 2 months after infection; subcultivation and primary testing for sensitivity to INH proved them to be invariably sensitive to 10 µg of INH, and completely or partially sensitive to 1 µg of INH. The remaining 17 strains caused little or no tuberculosis to develop in the guinea pigs within the 2-month period before sacrifice. The tuberculosis which did develop consisted of local abscesses at the sites of injection and occasional necrotic lymph nodes draining these sites. Subcultivation from these lesions revealed either no cultivatable bacterial cells or populations consisting predominantly of tubercle bacilli resistant to more than 1 µg of INH. Of some interest is the fact that all these local lesions at the sites of inoculation contained acid-fast rods demonstrable on direct smear.

Of special significance for our present studies is our unexpected observation that 8 of these nonpathogenic strains of tubercle bacilli failed to grow on the unmodified OA medium, although 5 of them gave good growth on the ATS medium. The 3 remaining strains, which failed to grow on either OA medium or the ATS medium, and which did not produce progressive disease in guinea pigs are of particular interest to us. All 3 of these patients persistently cough up acid-fast rods which are invariably present on direct smear and present in enormous numbers in sputum concentrates. There is little doubt in our minds that these acid-fast rods must derive from a multiplying population in their respiratory tracts—in all likelihood in one or more of the cavities which are visible by x-ray in these patients. Cultures of tubercle bacilli were readily isolated on egg medium from these patients before INH therapy was initiated. It seems possible that these observations are related, at least in part, to Fisher's observation (2) that a variant of the H37Rv strain, resistant to more than 10 µg of INH/ml of medium, has growth requirements different from the parent INH-sensitive H37Rv strain.

We wish to emphasize that these data refer only to pathogenicity of tubercle bacilli for normal guinea pigs, because, as yet, we have no direct, conclusive evidence that these INH-resistant strains of tubercle bacilli are equally nonpathogenic for normal human tissue. Indeed, it is already clear that these organisms can proliferate in open cavities in human lungs. Thus, it would appear that with the development of resistance to the antimicrobial effects of INH, tubercle bacilli acquire an inability to initiate multiplica-

tion in normal, non-necrotic areas of guinea pig tissue.

As is well known, tubercle bacilli multiply in lung cavities in association with many autolyzing leukocytes. Therefore, it is tempting to postulate that most strains of tubercle bacilli which are resistant to more than 10 µg of INH/ml of artificial medium have a special growth requirement for a substance (or substances) which, on the one hand, is present but bound and unavailable in normal tissue, but, on the other hand, free and available to these fastidious strains in necrotic tissue. This substance (or substances) is evidently present in moderate but not always sufficient amount in egg yolk media, and is present in much smaller quantities in the OA medium.

We would like to point out and warn that the population of tubercle bacilli which appears in the sputum of an INH-treated patient, may, and often does, consist of mixed populations of organisms with various degrees of resistance to INH and, thus, of mixed populations with varying degrees of pathogenicity. Also, reversion of strains from INH-resistance and nonpathogenicity for normal tissue to INH-sensitivity and pathogenicity has already occurred in our laboratory on repeated subcultivation in medium deficient in the special growth factor(s) to which we have already referred. The observations reported here have many implications for the future with respect to the diagnosis, treatment, and epidemiologic control of tuberculosis. These are beyond the scope of this paper.

References

1. MIDDLEBROOK, G. *Am. Rev. Tuberc.*, **65**, 765 (1952).
2. FISHER, M. W. *Ibid.*, **66**, 626 (1952).

Manuscript received April 27, 1953.

Radioactive Measurement of Proteolytic Activity

George L. Nardi

Department of Surgery of the Harvard Medical School and the Surgical Services at the Massachusetts General Hospital, Boston

Proteolytic enzymes play a vital role in many physiological and pathological phenomena of the body. Not only are they essential for normal every day economy, but abnormalities in their concentration have been believed to be the cause of many pathologic states. Among these are: pancreatitis (1, 2), obstetrical complications (3), bleeding dyscrasias (4), venous thrombosis (5), and cancer (6).

The measurement of this proteolytic activity in body fluids has been quite difficult. Most methods have not been direct since they measure antiproteolytic factors, nor have they lent themselves to simple quantitative measurement (2, 7, 8).

A procedure for direct quantitative estimation of proteolytic activity has been devised. The principle of the method depends upon the digestion of I^{131} -labeled albumin by a proteolytic enzyme. This will result in

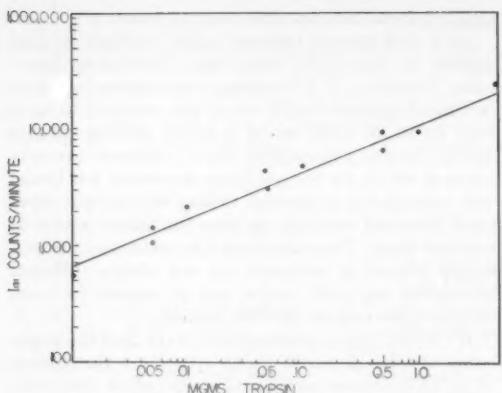


FIG. 1.

formation of unbound radioiodine that, though not necessarily in inorganic form, is no longer attached to the whole protein and may be separated from the latter by selective precipitation of the albumin. The radioactivity contained in the supernatant should then be proportional to the proteolytic activity of the enzyme.

Radioactive iodinated albumin is dialyzed against cold running water for 72 hr to free it of any unbound inorganic I¹³¹. The proteolytic solution is then added to the labeled albumin. After 20 min, 1 cc of β-naphthalene sulfonic acid and 1 cc of human serum albumin as a carrier are added to precipitate the proteins. The mixture is centrifuged and the supernatant plated and counted with a thin end-window Geiger-Müller tube.

The results using varying concentrations of trypsin (Tryptar-Armour) in 1 cc of solution are shown in Fig. 1.

References

1. INNERFIELD, I., ANGRIST, A., and BENJAMIN, J. W. *Gastroenterology*, **19**, 843 (1951).
2. ———. *Am. J. Med.*, **12**, 24 (1952).
3. SCHNEIDER, C. L. *Surg. Gynecol. Obstet.*, **92**, 27 (1951).
4. RATNOFF, O. D. *J. Clin. Invest.*, **31**, 521 (1952).
5. SPROUL, E. E. *Am. J. Cancer*, **34**, 566 (1938).
6. EDWARDS, E. A. *New Eng. J. Med.*, **240**, 103 (1949).
7. DOWNIE, G. R., and CLIFFTON, E. E. *Proc. Soc. Exptl. Biol. Med.*, **71**, 138 (1949).
8. CHRISTENSEN, L. R., and MACLEOD, C. M. *J. Gen. Physiol.*, **28**, 559 (1945).

Manuscript received March 18, 1953.

Various Absorption Coefficients for 23.5-Mev X-Rays

W. S. Moos, W. J. Henderson, and J. W. Beattie

*Department of Radiology,
University of Illinois, School of Medicine, Chicago*

In choosing the material for a window through which one can view patients receiving betatron x-ray therapy, it was necessary to measure the half-value

TABLE 1
23.5 MEV X-RAYS

Material	Half-value layer	Absorption coefficient
Water	29.6 cm	0.023 cm ⁻¹
Glass	11.9 cm	0.058 cm ⁻¹
Zinc bromide	9.4 cm	0.074 cm ⁻¹
Lead glass	3.6 cm	0.19 cm ⁻¹
Lead	1.4 cm	0.48 cm ⁻¹

layers of glass,¹ lead glass, water, and zinc bromide.² It was found necessary to have a protective window-thickness providing about 8–9 half-value layers of absorbing material to protect the betatron personnel in the control room satisfactorily.

K. R. Ferguson (1) and others have discussed various liquid and solid absorbers for window constructions that can be used for high energy radiation protection. In order to select the best material in respect to lowest space consumption and cost as well as chemical stability, the following absorption coefficients were measured with a 23.5-Mev x-ray beam.

The absorption coefficients of glass, lead glass, and

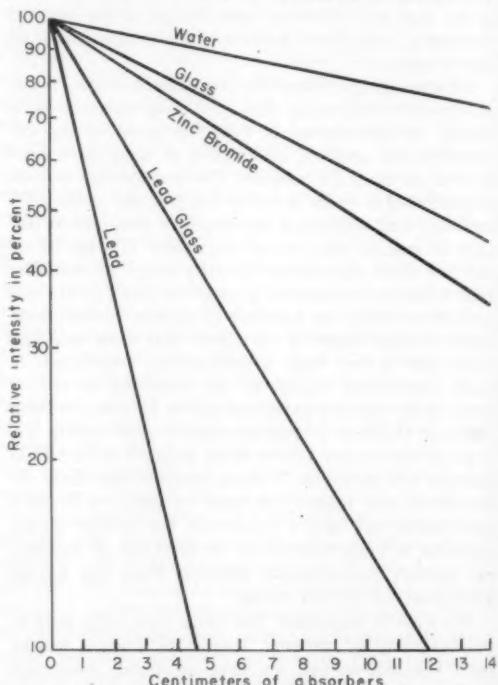


FIG. 1. Absorption qualities of various materials for protective windows against 23.5 Mev x-rays are shown. The lead curve is given for comparison.

¹ Samples of plate glass and lead plate glass were furnished by the Pittsburgh Plate Glass Company.

² Zinc bromide solution containing hydroxylamine hydrochloride to prevent coloring due to oxidation products was supplied by the Dow Chemical Company.

lead metal were determined by placing absorbers of these materials in front of a Victoreen thimble ionization chamber (25 r) situated within an 8-cm square lucite block (2) at a distance of approximately 100 cm from the betatron target. A well-collimated and uniform 6-cm-diameter beam of 23.5-Mev maximum x-ray energy was employed.

The values for water and zinc bromide were measured in a lucite tank. A small ion chamber was moved along the axis of the beam by remote control (3). The instantaneous ionization current at any point was amplified and recorded. The field size was 10 × 12 cm at 100 cm from the target. Inverse square correction was applied to all readings. The characteristics of the different materials are shown in Table 1 and Fig. 1. Measured values for lead are given for comparison.

It should be noted that the data show only the rate of absorption due to ionization after the electronic equilibrium has been reached, which is at approximately a depth of 4 cm for water.

References

1. FERGUSON, K. R. *Nucleonics*, **10** (1952).
2. HARVEY, R. A., HAAS, L. L., and LAUGHLIN, J. S. *Radiology*, **58**, 23 (1952).
3. LAUGHLIN, J. S., et al. *Am. J. Roentgenol. Radium Therapy*, **65**, 787 (1951).

Manuscript received May 29, 1953.

The Dynamic Equilibrium between Circulating and Extravascular Plasma Proteins¹

David Gitlin and Charles A. Janeway²

Department of Pediatrics, Harvard Medical School,
and the Children's Medical Center,
Boston, Massachusetts

It has been demonstrated that after intravenous administration of native (1) and labeled heterologous (1, 2) and homologous (3-6) plasma proteins to animals and labeled (6) and native (7, 8) homologous plasma proteins to humans, approximately half of the administered plasma protein, exclusive of that amount catabolized, leaves the circulation within the first few days. The importance of the nature of the label, the manner in which labeling has been performed, and, in the case of heterologous proteins, the activity of the reticuloendothelial system and the influence of antibody production in these experiments has been discussed (1, 6).

The extravascular distribution of native heterologous plasma proteins in animals (9, 10) and native homologous plasma proteins in humans (7, 11) has also been investigated; specific plasma proteins were found in the connective tissues and in the cells of many organs. In instances of a marked deficiency of a

specific circulating plasma protein in humans, γ -globulin in agammaglobulinemia (8) and fibrinogen in congenital afibrinogenemia (7), it has been found that extravascular sites in these patients are also depleted of the specific plasma protein (7, 11). Extravascular deficits of the given plasma protein in these patients could be quickly rectified by intravenous administration of the protein (7, 11).

Although it has been demonstrated that an excess of a given plasma protein in the circulation will shift extravascularly, for a true equilibrium to exist between the intravascular and extravascular pools of plasma protein, it must also be shown that an excess in the extravascular compartment will result in movement of the protein into the circulation. It was the purpose of this investigation to demonstrate, if possible, the reversible nature of the shift of protein between the intravascular and extravascular compartments.

Rabbit antisera vs. pneumococcus type III polysaccharide were employed in this study since the antibody could be detected by its immunochemical reactivity with specific antigen without additional labeling. The antisera were passively transferred to normal rabbits, thus avoiding the question of synthesis by the host animal of the protein being measured. The levels of antibody in the circulation were determined by the method of Heidelberger *et al.* (12), the specific precipitates were measured spectrophotometrically (13). The antisera used were pooled, fractionated with ammonium sulfate at half (0.5) saturation, and the precipitate was dialyzed exhaustively against saline buffer ($\Gamma/2$ NaCl = 0.1, $\Gamma/2$ phosphate = 0.05) and then against 0.15 M NaCl. The filtered concentrated solution contained 16.9 mg antibody/ml and represented a 10% solution of protein. Prior to intravenous administration, a volume of blood equal to the amount of antiserum to be injected was removed from an ear vein. The following experiments were performed and the results are recorded in Fig. 1.

Expt. 1. Effect of exchange transfusion. Four rabbits were given 20 ml antiserum intravenously. At the end of the 4th day of equilibration, the right femoral vein in each of the rabbits was exposed, and a No. 19 polyethylene catheter was inserted through an incision in the vein wall.

A. Two of the rabbits were then given exchange transfusions of 300 ml of normal rabbit blood, with removal of blood and its replacement in 10-ml aliquots over a period of an hour. The exchanged rabbits demonstrated the expected fall in circulating antibody immediately following the procedure; a rapid rise in circulating antibody soon occurred.

B. The 2 control rabbits were not treated and they showed no significant alteration of circulating antibody other than a continued logarithmic decay over this same period.

Expt. 2. Effect of injection of specific antigen. A. Four rabbits were given 18 ml of antiserum intravenously, and at the end of the 2nd day were given 2.2 mg of pneumococcus polysaccharide III intra-

¹ Supported by a grant (RG-346) from the National Institutes of Health, U. S. Public Health Service, and a grant (No. 28) from the Playtex Park Research Institute.

² The authors wish to thank Lederle Laboratories, Inc., for the generous supply of rabbit antiserum and pneumococcus polysaccharide used in these experiments.

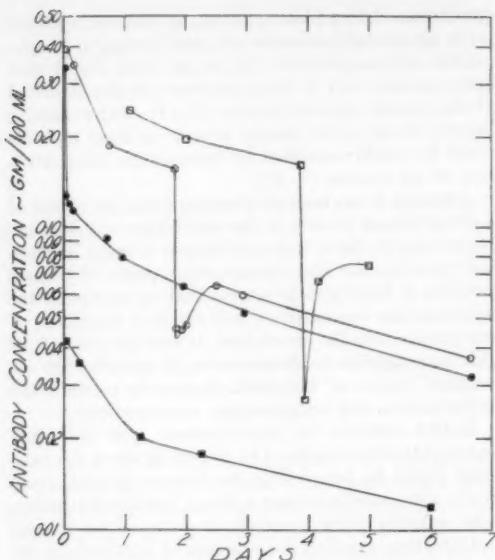


FIG. 1. All individual points on these curves represent the average values for the rabbits within a given experimental group. □ Expt. 1 A; ○ Expt. 2 A; ● Expt. 2 B; ■ Expt. 3.

venously in 1.0-ml volume, slowly. This amount of polysaccharide was calculated as enough to remove most but not all of the antibody circulating at that moment, the complex presumably being removed from the circulation in a short period of time. As can be seen, the level of circulating antibody fell immediately after administration of the specific antigen. A secondary rise soon occurred, however, and the circulating antibody then resumed its previous rate of logarithmic decline.

B. Two rabbits were given 15 ml of the same anti-serum intravenously and then, after 20 min, 2.2 mg of polysaccharide III were injected. An immediate fall in circulating antibody occurred; the antibody then assumed a logarithmic rate of decline proportionate and parallel to the curve for the 4 rabbits in Expt. 2 A, and closely approximating it after the secondary rise in circulating antibody had taken place in the latter rabbits.

Expt. 3. Effect of reinfusion of antibody removed after equilibrium reached. To determine if the initial rapid fall in circulating antibody, observed in the rabbits of Expt. 2 A before the decline became exponential, was dependent upon the disappearance of antibody molecules with markedly shorter half-lives, serum derived from blood removed from the rabbits of Expt. 1 A during exchange transfusion was injected into 2 other rabbits after 3-fold concentration by negative pressure dialysis and centrifugation twice at 4000 rpm at 0° C for 30 min. Twenty-five milliliters of this serum were given intravenously to 2 rabbits after removal of 25 ml blood. The same initial rapid fall was observed. Since the donor rabbits had been in

equilibrium with respect to circulating antibody, the derived serum presumably should have contained little or no antibody of very short half life. Hence it seems reasonable to conclude that the initial rapid fall following infusion of a plasma protein is, as has been previously postulated, an equilibration of the circulating protein with the extravascular protein pool.

The half life of the rabbit antibodies in these experiments varied between 5 and 7 days, which agrees with the values already reported (14, 15).

It would appear from the data that preformed plasma protein present in the extravascular pool can move rapidly into the circulation upon depletion of the specific protein in the latter compartment. Thus, the extravascular plasma protein is in dynamic equilibrium with the intravascular plasma protein; once equilibrium is established, a decrease in the mass of a specific plasma protein in one compartment results in the movement of that plasma protein to that compartment until equilibrium is again attained.

References

1. GITLIN, D., et al. *J. Immunol.*, **66**, 451 (1951).
2. DIXON, F. J., BUKANTZ, S. C., and DAMMIN, G. J. *Science*, **113**, 274 (1951).
3. MILLER, L. L., et al. *J. Exptl. Med.*, **90**, 297 (1949).
4. ABDOU, I. A., and TARVER, H. *J. Biol. Chem.*, **190**, 769 (1951).
5. ———. *Proc. Soc. Exptl. Biol. Med.*, **79**, 102 (1952).
6. STERLING, K. J. *Chin. Invest.*, **30**, 1228 (1951).
7. GITLIN, D., and BORGES, W. H. *Blood*. In press.
8. JANEWAY, C. A., APT, L., and GITLIN, D. In preparation.
9. COONS, A. H., LEDUC, E. H., and KAPLAN, M. H. *J. Exptl. Med.*, **93**, 173 (1951).
10. GITLIN, D., et al. In preparation.
11. GITLIN, D., LANDING, B., and WHIPPLE, A. *J. Exptl. Med.*, **97**, 163 (1953).
12. HEIDELBERGER, M., and KENDALL, F. E. *Ibid.*, **62**, 697 (1935).
13. GITLIN, D. *J. Immunol.*, **62**, 437 (1949).
14. HEIDELBERGER, M., et al. *J. Biol. Chem.*, **144**, 555 (1942).
15. GERMUTH, F. G., JR., OYAMA, J., and OTTINGER, B. *J. Exptl. Med.*, **94**, 139 (1951).

Manuscript received May 14, 1953.

A Homogeneous Cell Preparation from Soybean Leaves^{1,2}

D. W. Racusen and S. Aronoff

Institute for Atomic Research and the Department of Botany, Iowa State College, Ames

A typical dicotyledonous leaf is composed of three major types of tissue: epidermis, minor venation, and mesophyll. From the data of Wylie (1) these tissues appear to be present in roughly equal amounts. The specific biochemical contributions of the individual tissues to the general physiology of the leaf are essentially unknown (except, of course, for the photosynthesis of the mesophyll). Whereas epidermal cells may be obtained frequently merely by stripping, no procedure exists for obtaining mesophyll cells in

¹ Contribution No. LR-144.

² This work was supported by a grant from the Atomic Energy Commission and a fellowship to one of us (DWR) by the Oak Ridge Institute for Nuclear Studies.

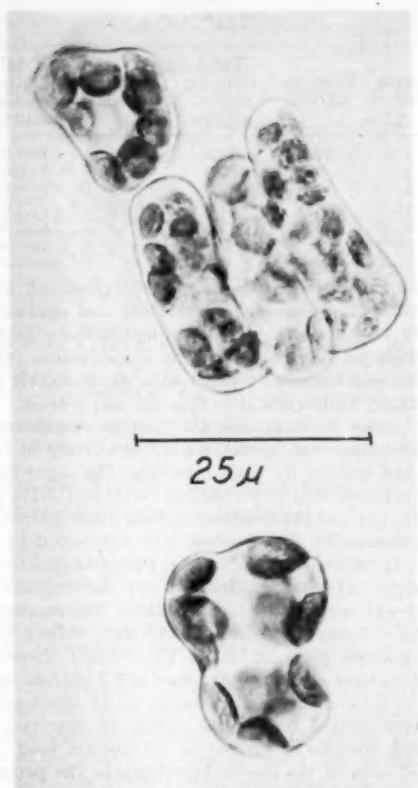


FIG. 1.

the
ittle
ems
fol-
een
lat-

ex-
rees

ned
ean
of
thus,
mili-
one
s of
ults
om-

ence,
769
.
tion.
xptl.
697

942),
B. J.

quantity. We find that soybean leaves (var. Hawkeye) will yield a tissue-free mesophyll preparation when carefully ground with 0.25 M sucrose, 0.05 M phosphate (pH 6.8) at ca 4° C. A test tube homogenizer with a loosely fitting pestle is used and the resulting suspension is filtered through bolting silk (ca 100 threads/in.). The filtrate is centrifuged at very low speed (ca 80 rpm) for several minutes. Upon discarding the supernatant and resuspending the cells in a nutrient solution, a tissue-free preparation of parenchyma cells is obtained (Fig. 1).

An illuminated, fresh cell preparation is capable of fixing C^{14}O_2 at a rate corresponding roughly to one-fifth that of a normal leaf on the basis of chlorophyll concentration. The intact excised leaf and the cell suspension show qualitative equivalence in the formation of 80% ethanol-soluble products (Fig. 2) and starch- C^{14} , but they are vastly different in their abilities to synthesize protein. While a leaf will form 10–15% of the total ethanol-insoluble material as protein in 30 min, the free-cell preparation will form none. The latter system has been subjected to various time, temperature, and nutrient conditions, without any evidence of radioactivity in the protein. That this is not an artifact arising from the method of preparation was shown as follows. An intact excised leaf was exposed to C^{14}O_2 in the light for 2 hr. A cell suspension was then made by our usual technique, analysis of which showed a large fraction of the radioactivity in the protein.

However, the failure of the cell preparation to form protein is not correlated with the inability to form amino acids from photosynthate. In the 30-min photosynthesis the cells had accumulated ca 35% of their 80% ethanol-soluble radioactivity in the form of the amino acids alanine, glutamine, aspartic acid, glycine,

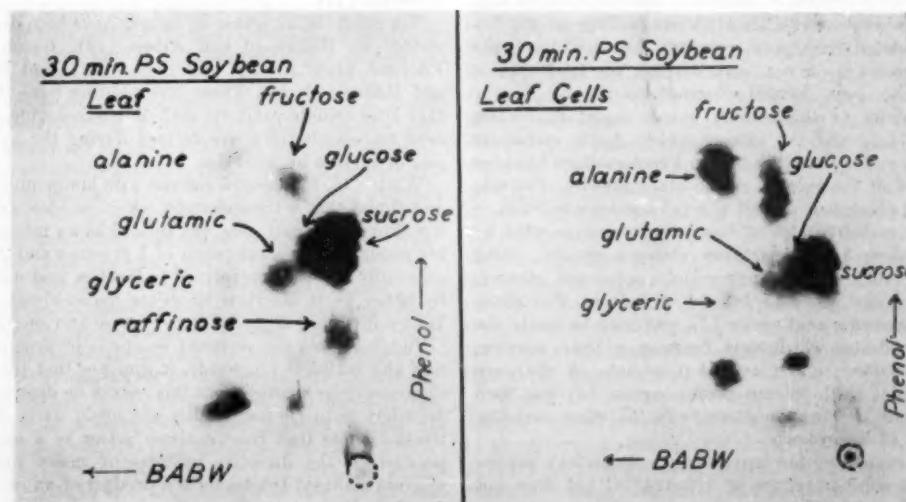


FIG. 2.

and serine.³ It is apparent that the cells are unable to form protein from these amino acids. The system is thus unique in that it demonstrates protein synthesis to be a more sensitive reaction than photosynthesis. Unfortunately, another physiological malfunction is the rapid decrease in the rate of photosynthesis with the age of the preparation, without visible sign of deterioration. The loss in the ability to assimilate C¹⁴O₂ is essentially logarithmic, only 20% of the original rate remaining after 1 hr at 23° C (in weak light prior to stronger illumination). It is, of course, possible that the same factors operating in negating protein synthesis are involved in the degradation of the photosynthetic system.

The preparation is intriguing as a possibility for the study of the nutrition and function of a specific type of tissue in leaves, akin to that of a highly specific organ in an animal.

Reference

1. WYLIE, R. D. *Am. J. Botany*, **30**, 273 (1943).

Manuscript received April 27, 1953.

³ These are also the only amino acids formed by an intact leaf within the same time period. The fact is that even without the simultaneous formation of all the essential amino acids, protein synthesis (probably partial turnover) occurs in excised leaves. This question will be discussed in a subsequent publication.

Fructomaltose, a Recently Discovered Trisaccharide Isolated from Honeydew

Henry E. Gray and G. Fraenkel

Department of Entomology,
University of Illinois, Urbana

A trisaccharide, fructomaltose, has been isolated from the honeydew produced by the citrus mealy bug, *Pseudococcus citri* (Risso), while feeding on the sap of etiolated Irish potato sprouts. Fructomaltose was not present in the potato sprout sap. The trisaccharide has also been located chromatographically in the honeydews of the cottony maple scale, *Pulvinaria vitis* (L.), and the spirea aphid, *Aphis spiraecola* Patch, and in honeybee honey. Fructomaltose has been located in the excreta of the black blowfly, *Phormia regina* (Meigen), when it was fed a sucrose solution.

The carbohydrates of honeydew were separated by descending paper partition chromatography, using Whatman No. 1 filter paper and a *n*-butanol, ethanol, acetone, and water (5-4-3-2 v/v) solvent. Benzidine-trichloroacetic acid spray (1) was used to locate the carbohydrates which were fructose, glucose, sucrose, fructomaltose, and glucose-1-phosphate. A charcoal-infusorial earth column chromatogram (2) was used to isolate the fructomaltose from the other carbohydrates of honeydew.

Fructomaltose is nonreducing to Benedict's copper sulfate solution, chars at 118-124° C but does not melt, is dextrorotatory, and apparently is very hygroscopic. A satisfactory rotation value has not been ob-

TABLE I

Sample No.	Fructose, $\mu\text{g}/\text{mm}$	Total reducing sugars, $\mu\text{g}/\text{mm}$	Maltose, $\mu\text{g}/\text{mm}$	Weight ratio Fructose/maltose
1	17.5	52.9	34.5	1: 1.97
2	8.2	25.0	16.8	1: 2.05
3	13.2	44.5	30.9	1: 2.27
4	8.0	24.6	16.6	1: 2.07
5	14.0	45.8	31.8	1: 2.27

tained and the sugar has not been crystallized. Fructomaltose is hydrolyzed to fructose and maltose by either yeast invertase or dilute hydrochloric acid, to fructose, glucose, and sucrose by human saliva, and to glucose and sucrose by pancreatin. Hydrochloric acid eventually hydrolyzes it to fructose and glucose.

In order to determine the monosaccharide ratio, fructomaltose was hydrolyzed quantitatively to fructose and maltose by yeast invertase. The sugar-invertase solution was deproteinized with Ba(OH)₂ and ZnSO₄ (3) and the fructose/maltose ratio determined colorimetrically. The fructose was determined by the Roe (4) method and the total reducing sugars by the Somogyi (5) method. Nelson's (6) chromogenic reagent was used in the latter method. The results obtained are shown in Table I. The data show a fructose/maltose ratio of 1:2, by weight; therefore, fructomaltose contains 1 fructose and 2 glucose units.

It is believed that fructomaltose is an intermediate product formed during the action of invertase on sucrose. Sucrose is present in the normal food supply of each of the insects investigated. The presence of invertase in insect digestive systems has been demonstrated by many investigators including Sarin (7), Bertholf (8), Phillips (9), Herford (10), and Fraenkel (11).

The effects of invertase on sucrose have been demonstrated by Blanchard and Albon (12), Bacon and Edelman (13), Aronoff and Bacon (14), and White and Maher (15, 16). These investigators have shown that intermediate products such as trisaccharides, and even tetrasaccharides, are formed during the hydrolysis of sucrose by invertase.

White (15, 16) treated sucrose with honey invertase and found that a trisaccharide, which he identified as α -maltosyl- β -D-fructoside was formed as an intermediate product. It was composed of 1 fructose and 2 glucose units and was hydrolyzed to fructose and maltose by either yeast invertase or dilute hydrochloric acid. Honey invertase degraded it to glucose and sucrose.

Judging from the reported reactions of fructomaltose and maltosyl fructoside, it appears that the two sugars may be identical, but this cannot be determined definitely until further studies are made. It is of interest to note that fructomaltose arises as a natural product in the digestive systems of many insects, whereas maltosyl fructoside is a product of an *in vitro* reaction. Present studies indicate that fructomaltose may be expected to arise in the digestive system of any

animal that possesses invertase and utilizes sucrose in its diet.

References

1. BACON, J. S. D., and EDELMAN, J. *Biochem. J.*, **48**, 114 (1951).
2. WHISTLER, R. L., and DURSO, D. F. *J. Am. Chem. Soc.*, **72**, 677 (1950).
3. SOMOGYI, M. *J. Biol. Chem.*, **160**, 69 (1945).
4. ROE, J. H. *Ibid.*, **107**, 15 (1934).
5. SOMOGYI, M. *Ibid.*, **195**, 19 (1952).
6. NELSON, N. *Ibid.*, **153**, 375 (1944).
7. SARIN, E. *Biochem. Z.*, **120**, 250 (1921).
8. BERTHOLD, L. M. J. *Agr. Research*, **35**, 429 (1927).
9. PHILLIPS, E. F. *Ibid.*, **35**, 385 (1927).
10. HERFORD, G. V. B. *Ann. Appl. Biol.*, **22**, 301 (1935).
11. FRAENKEL, G. J. *Exptl. Biol.*, **17**, 18 (1940).
12. BLANCHARD, P. H., and ALBON, N. *Arch. Biochem.*, **29**, 220 (1950).
13. BACON, J. S. D., and EDELMAN, J. *Ibid.*, **28**, 467 (1950).
14. ARONOFF, S., and BACON, J. S. D. *Arch. Biochem. and Biophys.*, **41**, 476 (1952).
15. WHITE, J. W., Jr., and MAHER, J. *Ibid.*, **42**, 360 (1953).
16. ———. *J. Am. Chem. Soc.*, **73**, 1259 (1953).

Manuscript received May 4, 1953.

Malignant Tumors Resulting from Embedding Plastics in Rodents¹

B. S. Oppenheimer, Enid T. Oppenheimer,
Arthur Purdy Stout, and I. Danishefsky

Institute of Cancer Research,
College of Physicians and Surgeons,
Columbia University, New York City

In two previous communications (1, 2) we have described various types of sarcomas which were induced in rats and mice by embedding certain plastic films in the anterior abdominal wall just ventral to the fascia. The initial observations were made on rats in which one kidney had been wrapped in cellophane to produce hypertension. Seven of these rats, autopsied after nearly 2 yr, were found to have developed sarcomas around the wrapped kidney. Later experiments showed that subcutaneous embedding produced similar results and the abdominal wall technique is now generally used by us.

In addition to cellophane (regenerated cellulose) we have embedded a number of other plastics and have produced malignant tumors in a considerable percentage of the animals. These are all long-term experiments lasting usually 1-2 yr before the appearance, if at all, of a sarcoma. The final results of some of these experiments cannot be reported as yet, since in many cases the time elapsed after embedding has not been sufficient for the appearance of tumors.

Nevertheless there are practical reasons for publishing further results now, as plastics are being used more and more extensively on humans by surgeons and surgical specialists. It is, however, very important to note that so far there is no proven instance in the literature of a malignant tumor induced in man by embedding a plastic. (Paraffinomas are foreign-body reactions, not malignant growths.) On the other hand, oncologists have reminded us that if it takes 1-2 yr

TABLE 1
TUMORS OBTAINED BY EMBEDDING PLASTICS
SUBCUTANEOUSLY

Material	Animals	Completed Experiments	
		No.	%
Cellophane A	Rats	15/42	35.7
Cellophane A	Mice	8/35	22.8
Cellophane A	Mice (black)	1/22	
Cellophane B	Rats	20/44	45.4
Polyethylene A	Rats	10/80	12.5
Pure polyethylene	Rats	7/38	18.4
Pure polyethylene	Mice	3/29	10.3
Polyvinyl chloride	Rats	17/44	38.6
Glass coverslip	Rats	1/50	

Material	Animals	Experiments Still in Progress	
		Malignant tumors produced	Animals still alive
Cellophane C	Rats	11	16
Pure polyethylene perforated textile	Rats	1	30
Silastic	Rats	12	3
Teflon	Rats	4	15
Nylon	Rats	1 ^a	21
Dacron	Rats	3	29
Dacron perforated	Rats	1	30
Polystyrene	Rats	2	22

for a malignant tumor to appear in a rodent, it may take 10-15 yr for a similar result in a human being.

Malignant tumors, adjacent to or actually surrounding the film, have been produced in rats or mice or both with the following plastics: (1) commercial cellophane film (regenerated cellulose), for convenience called by us Cellophane A; (2) the same cellophane film after it had been subjected to intensive extraction by methyl alcohol, called Cellophane B; (3) the same cellophane subjected first to alcohol and subsequently to benzene extraction, called Cellophane C; (4) polyethylene film, called Polyethylene A; (5) a pure polyethylene film, specially prepared for these experiments; (6) polyvinyl chloride film; (7) silastic, a silicone product; (8) Teflon film; (9) Dacron film; (10) polystyrene film; (11) with nylon film, so far only one tumor, a reticulum cell sarcoma surrounding the nylon, has appeared, 441 days after insertion. Successful transplantation of this tumor was made, producing reticulum cell sarcomas to the second generation. The remaining rats embedded with nylon are still under observation.²

To date the highest percentage of positive results (45.4%) was obtained by embedding cellophane B. Up to the present we have obtained a total of at least 126 primary tumors, including those from kidney wrappings, and many successful transplantsations.

¹ This work was supported by a grant from the National Cancer Institute, U. S. Public Health Service.

² Since the above was written 3 more sarcomas have appeared at the site of embedding nylon film.

At least 23 more substances (mostly other polymers or variants on those mentioned before) are being tested for their carcinogenicity, but they have been embedded too recently for any report at this time.

In addition to these plastics, we have similarly embedded other materials as controls. Adequate controls are of the greatest interest and importance in such an investigation; and, at this point an addendum must be made to our previous report in 1952 (2). In that publication we stated that up to that time no tumors had appeared with the three substances embedded as controls; i.e., (a) the linters from which the Cellophane A was manufactured, (b) sterile surgical cotton, and (c) chemically clean cover glasses. Recently, however, just before the completion of this last cover glass experiment, we obtained a solitary fibrosarcoma that surrounded a cover glass; this tumor appeared 659 days after the embedding, and was successfully transplanted. The cover glass was found broken into two fragments, but similar breaks were frequently found in the cover glasses that did not cause tumors. No certain explanation of this one exception among the controls can be made, but it is possible that some unknown carcinogen accidentally contaminated the cover glass at the time of the operation. In view of this single exception, a new series of control experiments is under way.

Subsequent to our publication, but independently, Druckrey (3) has induced sarcomas by similar procedures, using regenerated cellulose film and Polyamid film. He also produced peritoneal sarcomas by embedding platelets of cellophane in the peritoneal cavity of rats. Druckrey also observed that another rat, which had received cellophane orally, developed lymphatic leukemia (lymphosarcoma) with malignant infiltration of the lymph nodes, liver, spleen, and lung. As this was the only such observation, we are speculating as to whether or not the leukemia was perhaps spontaneous.

The mechanism of production of these malignant sarcomas presents an interesting problem, and experiments are in progress to try to find an explanation. Types of tumors produced by embedding plastics are:

(1) *Malignant*: fibrosarcoma (the great majority are of this type), rhabdomyosarcoma, liposarcoma, osteogenic sarcoma, reticulum-cell sarcoma, lymphosarcoma, rhabdomyosarcoma (atypical), undifferentiated sarcoma, plasmocytoma, histiocytoma, myxoma, malignant mesenchymoma.

(2) *Nonmalignant*: 2 granulomas.

Table 1 shows the tumors obtained by embedding various plastics under the skin, the rodent used, the number of malignant tumors produced and the respective percentages.

References

1. OPPENHEIMER, B. S., OPPENHEIMER, E. T., and STOUT, A. P. *Proc. Soc. Exptl. Biol. Med.*, **67**, 38 (1948).
2. ———. *Ibid.*, **79**, 866 (1952).
3. DRUCKREY, H., and SCHMAHL, D. Z. *Naturforsch.*, **7b**, 353 (1952).

Manuscript received May 10, 1953.

Volumetric Flasks and Microcell Filling Adapter for Use with the Perkin-Elmer Infrared Spectrophotometer¹

O. D. Easterday,² F. Welden, R. M. Featherstone, J. P. Hummel, and E. Goldberg

Departments of Pharmacology, Biochemistry, and Urology, College of Medicine, State University of Iowa, Iowa City

One of the problems encountered in quantitatively handling a very few milligrams of material in a solution of a concentration great enough to permit the preparation of good infrared absorption records has been solved to a great degree with the use of the apparatus illustrated in Figs. 1 and 2.

The 1-mm Perkin-Elmer microcell (Fig. 1) re-

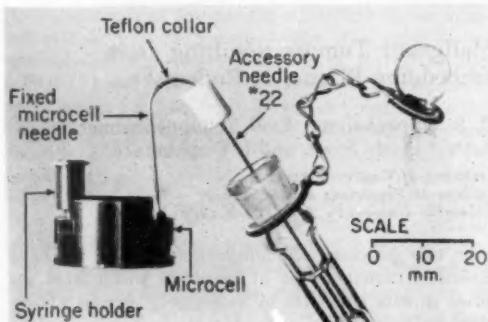


FIG. 1.

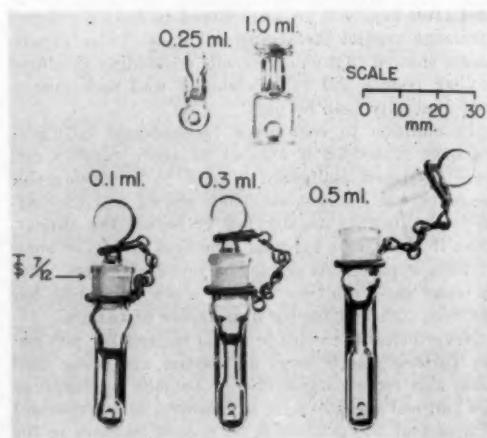


FIG. 2.

¹ Taken from a thesis submitted by O. D. Easterday as partial fulfillment for the degree Doctor of Philosophy. This work has been supported by grants from the Wm. S. Merrell Co., Cincinnati, and the American Cancer Society.

² Fellow of the National Institute of Arthritis and Metabolic Diseases, United States Public Health Service.

quires a volume of about 0.04 ml. By using a Teflon collar to connect the microcell needle to a second length of needle, it was possible to fill the cell from a solution volume of 0.1 ml by capillary action or by syringe in the usual manner. Thus the study of a 1-mg sample of a compound in 1% solution is possible. The flask illustrated in Fig. 1 has a calibration scratch on the constricted neck and a mixing bead which is slightly larger than the neck. The region of the flask above the neck is funnel shaped to allow easy addition of the sample by tapping the side of the flask with the finger. The glass stopper permits transportation and storage without loss due to evaporation.

Solvent additions are made by using a No. 22 needle attached to a syringe.

Figure 2 illustrates several sizes of these flasks which have been used. The two at the top without glass stoppers are early models that were used successfully, but with difficulty, since many of the solvents are readily volatile. The lower models were made for us.³

³ Made by Thomas J. Scott, of Metro Industries, Long Island City 1, N. Y. They may be obtained commercially from this company.

Manuscript received April 27, 1953.



Comments and Communications

Sea Urchins Damage Steel Piling

SEA urchins have been discovered making holes in the steel 8-in. H-beam piles of a pier near Ellwood, California. The pier belongs to the Signal Oil and Gas Company and company engineers brought the problem to the Santa Barbara Museum of Natural History.

These piles, put down in 1929, had to be replaced when their damaged condition was discovered. The culprit was identified as the purple sea urchin, *Strongylocentrotus purpuratus*, a species that often bores in surf-pounded rocks and reefs.

On the steel piles they clung to the lower few feet, where they nestled in the depressions they had made. When removed, the metal under them was clean, bright, and rough.

Their action apparently augments corrosion. So many holes had already been made clear through the $\frac{3}{8}$ -in. web of the H-beam that it was all eaten away at the bottom, leaving the lower few feet of the flanges completely separated. About half of the 40 piles pulled at this pier were damaged in this way, and the engineers are anxious to learn how to prevent such expensive damage by sea urchins.

MARGARET CONSTANCE IRWIN

Santa Barbara Museum of Natural History
Santa Barbara, California

Received March 28, 1953.

Thiouracil and Adrenal Glands

IN a paper on "Adrenal Hypertrophy in the White Leghorn Cockerel after Treatment with Thiouracil and Thyroidectomy" by Morris (1), the author erroneously ascribes to Baumann and Marine (2) the observation that feeding thiouracil to albino rats causes "atrophy and degeneration of the adrenal gland." Dr. Morris has missed the point of our report, and his search for the mechanism involved will be made simpler by a more careful reading of our

work. What we stated was that the total weight of the adrenal gland is almost always decreased by feeding thiouracil due to an involution (not atrophy) of the adrenal cortex. The medulla (3) on the other hand, undergoes a very marked hypertrophy, rarely to such an extent that the weight of the entire gland may be increased, in spite of the great involution of the cortex.

We hope this comment will help Dr. Morris in analyzing his experiments on the chick.

EMIL J. BAUMANN
DAVID MARINE

Montefiore Hospital, New York City

References

1. MORRIS, D. M. *Science*, **117**, 61 (1953).
2. BAUMANN, E. J., and MARINE, D. *Endocrinology*, **36**, 400 (1945).
3. MARINE, D., and BAUMANN, E. J. *Am. J. Physiol.*, **144**, 69 (1945).

Received January 27, 1953.

Comparative Potency of a British and American Standard of Crystalline Vitamin B₁₂¹

THE growth of several microorganisms has been shown to be influenced by the vitamin B₁₂ concentration of the inoculated medium. These observations have led to the development of microbiological methods which are sensitive enough to assay the vitamin B₁₂ activity of body fluids. *Lactobacillus leichmannii* (1), and the green alga, *Euglena gracilis* (2, 3), have been found suitable for the assay of vitamin B₁₂ activity in serum. In both methods, the amount of growth of the organism in the test fluid is compared with that in a range of tubes containing varying known amounts of crystalline vitamin B₁₂. These latter tubes thus serve as standards.

¹ This study was made possible by a grant from the National Institutes of Health and in part by a grant from Squibb Institute for Medical Research.

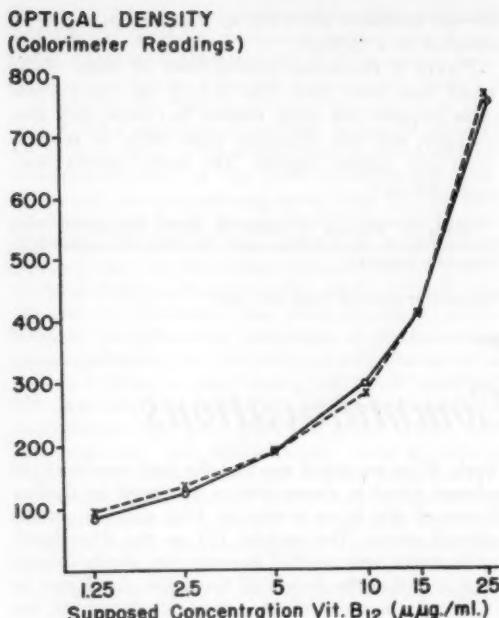


FIG. 1.

The normal range of vitamin B₁₂ concentration in human serum was found by Mollin and Ross (4), to be from 100 to 720 μg/ml, with a mean of 358 μg/ml. These results were obtained in England, using *E. gracilis* as test organism. Rosenthal and Sarett (5) in this country have found, by the *L. leichmannii* assay technique, a normal range of 80–420 μg/ml, with a mean of 200 μg/ml. Figures from this laboratory, using the Euglena method of assay, also tend to be lower than those reported by Mollin and Ross.

A possible source of this discrepancy could be a difference in the potency of the British and American standards of crystalline vitamin B₁₂. It was thought desirable therefore to compare the potency of a British² and an American³ preparation of crystalline vitamin B₁₂. Both products had been assayed by the respective manufacturers to contain 20 μg vitamin B₁₂/ml.

Freshly prepared dilutions of both standards were compared by their growth promoting effect for *E. gracilis*. Parallel dilutions were added to basal medium to give supposedly final concentrations ranging from 1.25 to 25 μg/ml. The density of growth of the *Euglena* for each dilution was recorded with a photoelectric colorimeter, using a red filter. Each dilution was tested in quadruplicate, and the readings averaged.

Growth pattern curves for the two preparations of vitamin B₁₂ have been constructed by plotting optical

² Cytamen, Glaxo Laboratories, Ltd., England.

³ Rubramin, E. R. Squibb & Sons, New York, N. Y.

density against the logarithm of the supposed concentration (Fig. 1). The curves are almost identical. The potency of these two preparations is therefore similar.

WILLIAM R. PITNEY
EVERETT H. SANNEMAN
MARION F. BEARD

Division of Hematology
University of Louisville School of Medicine
Louisville, Kentucky

References

1. THOMPSON, H. T., DIETRICH, L. S., and ELVEHJEM, C. A. *J. Biol. Chem.*, **184**, 175 (1950).
2. ROSS, G. I. M. *Nature*, **166**, 270 (1950).
3. ———. *J. Clin. Pathol.*, **5**, 250 (1952).
4. MOLLIN, D. L., and ROSS, G. I. M. *J. Clin. Pathol.*, **5**, 129 (1952).
5. ROSENTHAL, H. L., and SARETT, H. P. *J. Biol. Chem.*, **199**, 433 (1952).

Received February 2, 1953.

Fossil Deposits Under the Entrance of Carlsbad Caverns

FRAGMENTS of pottery and sandals, wall paintings, and nearby mesal roasting pits indicate that the entrance to Carlsbad Caverns has long been used by the desert Indians as a natural shelter. Cave breathing provides the sheltered area with warm air in winter. During the summer, forced evaporation of the moist cavern breezes, as they come in contact with the hot, dry, desert air, makes the cave cool. This natural air-conditioning and the presence of a few small seeps of water provided a nearly perfect camping site for hundreds or even thousands of years (Fig. 1).

Apparently, victims of the hunt were taken to the cave entrance, the discarded bones thrown into the hole at the rear, which leads into the deeper parts of the caverns (Fig. 2). Remains left on the floor were often washed into the same hole by rain water. Once through this hole, the water fell to the floor of the main corridor, where its velocity decreased and its load of sediment, plant and animal remains, and guano, was deposited.

For hundreds of years, guano accumulated and formed a valuable source of rich, natural fertilizer.



FIG. 1. Present entrance to Carlsbad Caverns. (Photo courtesy H. Hemler, Carlsbad, N. M.)

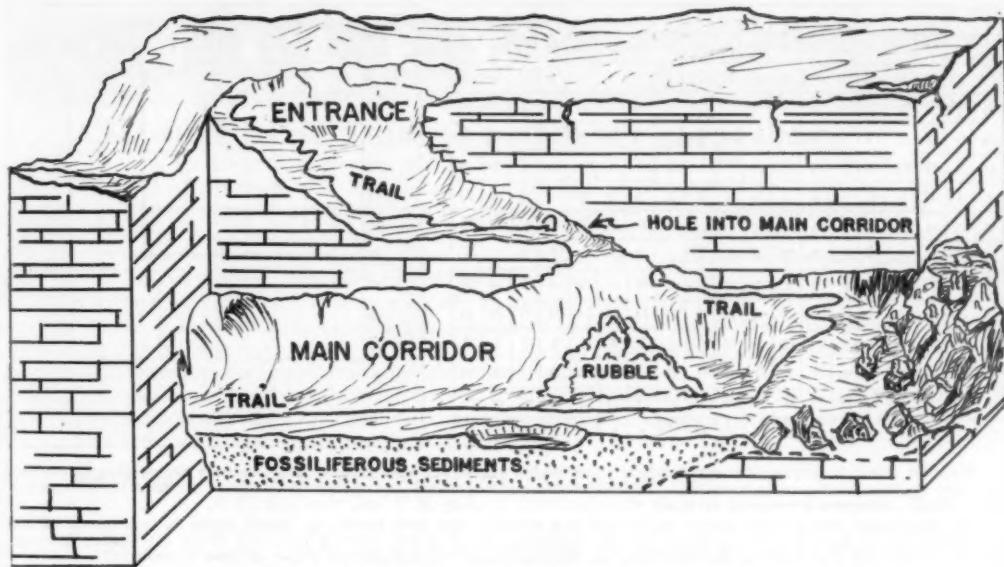


FIG. 2. Cross section through the Carlsbad Caverns entrance (not to scale).

Demands for this fertilizer by California citrus growers caused a mining company to remove the deposits and once again bare the fossiliferous sediments. One miner, J. L. White, became interested in the deeper, more scenic corridors and rooms. Stories told by him, and by those whom he guided through the caverns, created such a public demand to see the underground wonders that it was necessary to build trails to accommodate the increasing number of visitors.

Sediments of the fossil deposit were easily excavated and made excellent trail fill. It was the removal of this material that led to the original discovery of the gold mine of plant and animal remains. Careful sift-

ing of the dirt has resulted in the finding of teeth, horned-toad scales, bones of bats, rodent skulls, ribs and leg bones of many types of mammals, furculas and skulls of birds, a section of bone that had apparently been used as a bead by an Indian, and numerous bits of wood and leaves. The importance of this deposit has finally been recognized. Its study and deciphering will eventually unfold a fragmentary record of the men, plants, and animals that once lived in or near the entrance to Carlsbad Caverns.

DONALD M. BLACK

Carlsbad Caverns, New Mexico

Received February 4, 1953.

A Simple Two-Dimensional Slide Rule for the Rapid Calculation of Time Intervals

A SIMPLE two-dimensional slide rule has been designed with which any desired units of time may be quickly and accurately computed. The same type of instrument lends itself to the computation of many other types of data provided they can be arranged in true arithmetic sequence and set up in tabular form. The instrument consists of two parts, a special overlapping chart of data and a sliding transparent window, with a measuring scale on the frame. Figures 1A and B show how this idea is adapted for counting time in days. The window used is 10 columns wide and of any desired length. On the main chart all the information is placed in the first 10 columns from the left, and the first 9 vertical columns are shifted up

one row and duplicated, as in Fig. 1A. This arrangement allows any date or figure on the chart to be placed under the window in any desired position. This is the basic procedure to be followed in constructing any such chart.

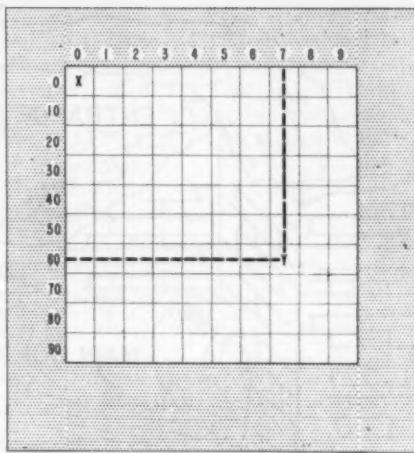
If information is needed in two units, e.g., pounds and ounces, the width of the window and the basic chart would be equal to the number of smaller units in the larger unit, e.g., 16(a) in the case of pounds and ounces. The whole chart would be 31(2a-1) columns wide, since all but the last column would be duplicated. The horizontal frame of the window would count off in smaller units, i.e., ounces, and the vertical frame the larger units, i.e., pounds.

One other type of computation for which the two-dimensional slide rule may be applied is that of a problem that can be reduced to the formula $(R-B)C$, where R is the reading, B a blank and C a constant. The chart would be set up to include values for RC

JAN.	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
21	22	23	24	25	26	27	28	29	30	31	FEB.	2	3	4	5	6	7	8
31	FEB.	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
20	21	22	23	24	25	26	27	28	MAR.	1	2	3	4	5	6	7	8	9
2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
22	23	24	25	26	27	28	29	30	31	APR.	1	2	3	4	5	6	7	8
APR.	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
21	22	23	24	25	26	27	28	29	30	MAY	1	2	3	4	5	6	7	8
MAY	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
21	22	23	24	25	26	27	28	29	30	JUNE	1	2	3	4	5	6	7	8

FIG. 1A (left). A portion of the main chart to be used in computing time in days, the length to be adjusted as desired. Note that the first 9 columns to the left are raised one row and duplicated on the right. Any section on the chart 10 columns wide will give an accurate sequence of dates.

FIG. 1B (right). The window overlay to be used with Fig. 1A. The area inside the dotted frame is transparent. Place the window on the chart in such a position that the beginning date is at zero position (x). Then locate the closing date (y) through the window and read the numbers from the window frame representing the elapse of time in days (67).



from $R=0$ to the largest value anticipated. In reading off computations, the window would be so placed that the number on the frame equal to B is placed opposite the value for $R=0$ on the chart, as 67 is placed opposite y in Fig. 1B. The computation for R would then lie at that point on the chart opposite the figures representing the R reading on the frame. Similar applications will no doubt suggest themselves. The full value of such an instrument can be appre-

ciated when a large number of computations is to be made.

M. RACHEL HARRIS

National Institute of Dental Research

National Institutes of Health

Public Health Service, Department of Health,
Education, and Welfare, Bethesda, Md.

Received February 26, 1953.

Scientific Book Register

Physical Formulae. T. S. E. Thomas. New York: Wiley; London: Methuen, 1953. 118 pp. Illus. \$2.00.

College Chemistry: A Systematic Approach. Harry H. Sisler, Calvin A. VanderWerf, and Arthur W. Davidson. New York: Macmillan, 1953. 623 pp. Illus. \$5.25.

Readings in Philosophy of Science. Introduction to the foundations and cultural aspects of the sciences. Philip P. Wiener, Ed. New York: Scribner's, 1953. 645 pp. Illus. \$5.50.

Introduction to the Theory of Finite Groups. Rev. ed. Walter Ledermann. Edinburgh-London: Oliver and Boyd; New York: Interscience, 1953. 160 pp. \$1.55.

The Characterization of Organic Compounds. Rev. ed. Samuel M. McElvain. New York: Macmillan, 1953. 303 pp. Illus. \$4.50.

Advances in Genetics, Vol. V. M. Demerec, Ed. New York: Academic Press, 1953. 331 pp. Illus. \$8.50.

Principles of Color Photography. Ralph M. Evans, W. T. Hanson, Jr., and W. Lyle Brewer. New York: Wiley; London: Chapman & Hall, 1953. 709 pp. Illus. \$11.00.

Laboratory Experiments in General Chemistry and Semi-micro Qualitative Analysis. George W. Watt and L. O. Morgan. New York-London: McGraw-Hill, 1953. 228 pp. Illus. \$3.50.

Modern Concepts in Medicine. Julius Jensen. St. Louis: Mosby, 1953. 636 pp. Illus. \$11.50.

Biological Stains. A handbook on the nature and uses of the dyes employed in the biological laboratory. 6th ed. H. J. Conn, with assistance of Elmer H. Stotz and Mary A. Darrow. Geneva, N. Y.: Biotech Pubs., 1953. 367 pp. Illus. \$5.00.

International Council of Scientific Unions, Vol. VI. Reports of proceedings of sixth general assembly held at Amsterdam October 1-3, 1952. F. J. M. Stratton, Ed. New York: Cambridge Univ. Press, 1953. 7s 6d.

Quackery in the Public Schools. Albert Lynd. Boston: Atlantic-Little, Brown, 1953. 282 pp. \$3.50.

Ballistocardiography. The application of the direct ballistocardiograph to clinical medicine. William Dock, Harry Mandelbaum, and Robert A. Mandelbaum. St. Louis: Mosby, 1953. 293 pp. Illus. \$9.50.

Investigation of Rates and Mechanisms of Reactions. Techniques of Organic Chemistry, Vol. VIII. S. L. Friess and A. Weissberger, Eds. New York-London: Interscience, 1953. 760 pp. Illus. \$12.50.

Essentials of Physiological Chemistry. 4th ed. Arthur K. Anderson. New York: Wiley; London: Chapman & Hall, 1953. 480 pp. Illus. \$5.00.

WILEY

BOOKS



A MANUAL for the ORGANIC CHEMISTRY LABORATORY

By LEIGH C. ANDERSON and the late WERNER E. BACHMANN, both of the University of Michigan. This beginning laboratory manual is the outgrowth of more than twenty years of pre-testing in undergraduate university classrooms. Planned for flexibility, it can be used with any text. It provides complete laboratory coverage. Each experiment in the manual includes equations, directions, and discussion of the principles involved. General laboratory procedures are outlined with reasons and precautions where necessary, so that a student will fully understand what is being done.

The experiments contained in "Anderson and Bachmann" illustrate the preparation of the important types of organic compounds and the application of the more important reactions. For many reactions, alternative preparations are given. The applications of numerous reactions which can be used in organic qualitative analysis are pointed out in both experiment and discussion, and the principles of separating mixtures and of purifying organic compounds are stressed. 1953. *In Preparation.*

PROCEDURES in EXPERIMENTAL METALLURGY

By A. U. SEYBOLT and J. E. BURKE, both with the General Electric Company. The material presented here—never before collected in one work—outlines in detail the major unit operations carried out in experimental work with metals. This is the first book to deal directly and comprehensively with the techniques of preparing metal samples up to the point of observation. It will not only be of great value to the metallurgy student, but will materially assist those in peripheral fields in gaining a better appreciation of the methods of the research metallurgist.

Featured in this book are: a summary of the methods of growing single crystals; an examination of the techniques of vacuum metallurgy; the application of refractories to metal research; an outline of the major unit operations carried out in doing experimental work with metals; and a list of the pure metals and their sources of supply. 1953. Approx. 352 pages. Prob. \$6.00.

Volume 33 of ORGANIC SYNTHESES

CHARLES C. PRICE, *Editor-in-Chief*. Like the previous volumes, the latest in this well-known and widely used series is designed to lighten the load of the organic chemist. All reactions have been checked by leading chemists throughout the country. In this volume, 64 contributors present a total of 40 new syntheses. 1953. 115 pages. \$3.50.

EXPERIMENTAL NUCLEAR PHYSICS

Volumes I and II

Edited by EMILIO SGRÈ, University of California. These volumes represent outstanding contributions to scientific literature, authored by outstanding leaders in nuclear science. They do a job which no one author could possibly do alone, because they gather together the data and theory which has catapulted our generation into the atomic age. Patterned after the early classic German handbooks, each volume includes articles which contain tables, numerical data, footnotes, references and indexes to make them as complete as possible in their coverage.

The aim of Dr. Segré, and of the other authors, is to bring to print modern experimental techniques; to point out truly significant facts and data; and to indicate the broad lines of present day interpretation. These are books that will be used again and again—both in the classroom and in the years to come.

Volume I—1953. 789 pages. \$15.00.

Volume II—1953. 600 pages. \$12.00.

Send for on-approval copies.

JOHN WILEY & SONS, Inc., 440-4th Ave., New York 16, N. Y.

Now available...

Adenosine Triphosphate (ATP); Amygdalin; Amylase; Animal Lecithin; Ascorbic Acid Oxidase; Bacitracin; BAL; Biotin, cryst.; Caffeic Acid; Carotene, cryst.; Catalase; Cellulase; Chlorogenic Acid; Chorionic Gonadotropin; Circulatory Hormone; Colchicine; Cystidylic Acid; Cytochrome C; Dehydroascorbic Acid; Diacetosamine; Dihydroxyacetone; Dihydroxyphenylalanine (DOPA); Dipyrromethane; Edestin; Emulsion; Erythritol; N-Ethylperidine; Fibroin; Folic Acid; Galacturonic Acid; Gentisic Acid; Girard Reagents P and T; Gliadin; Glucose Pentaacetate; Glucuronic Acid; Glyceraldehyde; Glyceric Acid; Heparin; Horseradish Peroxidase; Hyaluronidase; Hydriodine; 2-Hydroxyadipaldehyde; Humulon; Indan; Isoascorbic Acid; Isopropylarterenol; Kojic Acid; Kynurenic Acid; Lanthionine; Lipase; Lysozyme; Lyxose; Malononitrile; Maltase; Melezitose; Mesobioturbinogen; Muscle Adenylic Acid; p-Nitrophenylphosphate; Nucleoprotein; Orcinol; Pancreatin; Pantothenyl Alcohol; Penicillinase; Peroxidase; Phenazine; Phenylpyruvic Acid; Phlorizin; Phosphorylase; Piperin; Pyrrolyridine; Protamines; Protoporphyrin; Pyridoxal; Pyridoxamine; Pyrocatechic Acid; Pyruvic Aldehyde; Ribonuclease; Saccharic Acid; Salsolaine; Serine Phosphoric Acid; Spermidine; Spermine; Thioacetic Acid; Thiocytosine; Thyroxine; Trigonielline; Triphenyltetrazolium Chloride; Tripyridyl; Trypsinogen; Tyrosinase; Tyrothricin; Urease; Uricase; Uridine; Vitellin; Xanthosine.

Ask us for others!

DELTA CHEMICAL WORKS

23 West 60th St. New York 23, N.Y.
Telephone PLaza 7-6317

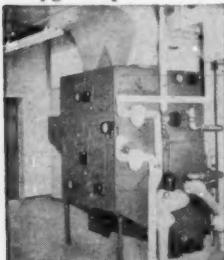
Drying Problem Solved by New Method

New, Niagara "Controlled Humidity" Method provides air at precise conditions of temperature and humidity and permits accurate variations of such conditions at will, in the range of 34°F. to 140°F.; also below 32°, if required.

This Method uses "Hygrol" liquid absorbent to remove moisture from the air directly, saving the cost of refrigeration for dehumidification. Operation is completely and reliably automatic; the absorbent is re-concentrated as fast as it is used.

It is used successfully in drying processes, control of hygroscopic materials, preventing moisture damage to materials or instruments, providing controlled atmosphere for tests and experiments. Units provide capacity ranges from 1000 c. f. m. to 20,000 c. f. m.

Write for Bulletin No. 112; address Niagara Blower Co., Dept. SW, 405 Lexington Avenue, New York 17, N.Y.



Publications Received

Annals of the New York Academy of Sciences. Mechanism of Corticosteroid Action in Disease Processes, Vol. 56, Art. 4. Roy Waldo Miner, Ed. 192 pp. Illus. + plates. \$3.50. *The Role of Growth Hormone in Carbohydrate Metabolism*, Vol. 57, Art. 2. R. C. de Bodo and M. W. Sinkoff. 38 pp. Illus. \$1.00. New York: New York Academy of Sciences, 1953.

Atomic Energy Commission: Fourteenth Semiannual Report. Washington, D. C.: Government Printing Office, 1953. viii + 98 pp. Illus.

Business Cycle Research and the Needs of Our Times. 33rd annual report. Arthur F. Burns. New York: National Bureau of Economic Research, 1819 Broadway, 1953. 86 pp.

Cerebral Changes Following Electrically Induced Convulsions. An experimental study on cats. Aeta Psychiatrica et Neurologica Scandinavica, Suppl. 77. Hans Hartelius. Copenhagen: Ejnar Munksgaard, 1952. 128 pp. Illus. 20 Swed. er.

Culture in Canada. A study of the findings of the Royal Commission on National Development in the Arts, Letters and Sciences, 1949-51. Albert A. Shea, Ed. Toronto: Canadian Association for Adult Education; Pasadena, Calif.: Fund for Adult Education, 914 E. Green Street, 1952. 65 pp.

The Duveen Collection of Alchemy & Chemistry. Supplementing the *Bibliotheca Alchemica et Chemica*. Catalogue 62. New York: H. P. Kraus, 16 East 46th St., 1953. 98 pp.

Eocene and Paleocene Deposits at Martinez, California. Charles E. Weaver. Seattle: University of Washington Press, 1953. 102 pp. and accompanying charts. \$4.00.

General Education Board: Annual Report, 1952. New York: General Education Board, 1953. 86 pp. Illus.

Guides to Meeting Tomorrow's Production Needs. Manufacturing series, No. 209. New York: American Management Association, 330 W. 42nd Street, 1953. 64 pp. \$1.25.

Influence of the Wash from Bronze on the Weathering of Marble. National Bureau of Standards, Building Materials and Structures Rpt. 137, 1953. Daniel W. Kessler and Ross E. Anderson. Order from Government Printing Office, Washington 25, D. C. 11 pp. Illus. 15¢.

List of Sugar-Cane Insects. A synonymic catalogue of the sugar-cane insects and mites of the world, and of their insect parasites and predators, arranged systematically. Harold E. Box. London: Commonwealth Institute of Entomology, 1953. 101 pp. \$2.25.

Parasitology, (1949-1950). Latin American contribution to scientific progress. Juan Enrique MacKinnon et al. Montevideo, Uruguay: Unesco Science Cooperation Office, 1953. 287 pp.

Symposium on Some Aspects of Microbial Metabolism. Oak Ridge, Tenn.: Biology Division, Oak Ridge National Laboratory, 1953. (Reprinted from *Journal of Cellular and Comparative Physiology*, Vol. 41, Supp. 1, March, 1953.) 282 pp. Free to scientists.

The Tilloodontia: An Early Tertiary Order of Mammals. C. Lewis Gazin. Smithsonian Misc. Coll., Vol. 121, No. 10. Washington, D.C.: Smithsonian Institution, 1953. vi + 110 pp. + plates.

The Truth about American Cars. Andrew J. White. South Lee, New Hampshire: Motor Vehicle Research, Inc., 1953. 48 pp. Illus. \$1.00.

New Mosby Books

Main-Richardson's PHYSIOLOGY

New Second Edition

Formerly known as *Synopsis of Physiology* by Main, this book has been popular with students and practicing physicians when they needed a *succinct* one that hit the high spots—while at the same time covering the essentials.

Dr. Richardson has revised it for this Second Edition into body systems with new chapters on metabolism, renal physiology, and the autonomic nervous system. Substantial additions have been made on the subjects of reflexes, respiration, body fluids and endocrinology. The book now presents in order, basic physiologic structures, homeostatic mechanisms, metabolic systems, fluid systems, and integrative principles. New findings on the hypothalamic functions have been brought up to date.

By ROLAND J. MAIN, Ph.D., Formerly Professor of Physiology, Medical College of Virginia. Revised by ALFRED W. RICHARDSON, Ph.D., Assistant Professor of Physiology, Indiana University. Second Edition. 475 pages, illustrated. Price, \$7.00

Potter's Laboratory Outline for

GENERAL ZOOLOGY

New Third Edition

Prepared for a course in elementary zoology, Potter's Laboratory Manual may be used with his own *Textbook of Zoology*—or any other textbook, or none. It is flexible enough for a two- or one-semester course—the material being so arranged that any instructor may easily select his needs. The author suggests portions for a short or long course, depending upon the needs of any class in which it is used.

It is Potter's conviction that a thorough and complete understanding of the laboratory portion of Zoology is essential for full understanding of the basic principles. On this premise, he has prepared an extensive and full laboratory outline, with directions and drawing sheets arranged with benefits to the instructor as well as to the student who is beginning—but with material leading him into intelligent investigation for his own development.

By GEORGE EDWIN POTTER, Ph.D., Professor of Zoology, A. & M. College of Texas, College Station, Texas; Formerly Professor of Zoology, Baylor University, Waco, Texas. Third Edition. 300 pages, illustrated. Price, \$3.50

Send orders and teacher inquiries to 3207 Washington Blvd., St. Louis 3, Missouri

Published by—

The C. V. MOSBY Company
Scientific Publications



SAINT LOUIS

SAN FRANCISCO

NEW YORK

**RESEARCH
BIOCHEMICALS**
For
INVESTIGATIONAL USE

AMINO ACIDS

A complete selection of more than 90 amino acids of maximum purity including:

DL ALPHA ALANINE
BETA ALANINE
L ALANINE
DL ALPHA AMINO-n-BUTYRIC ACID
L ARGinine (HCl, Free Base)
ASPARAGINE (L, DL, D)
ASPARTIC ACID (L, DL, D)
BETaine
DL CITRULLINE
CREATINE
CREATININE
CYSTEINE (HCl, Free Base)
CYSTEINE (L, DL)
DL DOPA
Djenkolic Acid
DL ETHIONINE
GLUTAMIC ACID (L, DL, HCl)
GLUTAMINE
GLYCYL GLYCINE
HISTIDINE (L, DL, D)
DL HOMOCYSTEINE
DL HOMOCYSTINE
HYDROXY-L-PROLINE
ISOLEUCINE (L, DL, D)
LEUCINE (L, DL, D)
LYSINE HCl (L, DL)
METHIONINE (L, DL, D)
METHIONINE SULFOXIDE
DL NORLEUCINE
DL NORVALINE
ORNITHINE HCl (DL, L)
PHENYLALANINE (L, DL, D)
PROLINE (L, DL)
SARCOSINE
DL SERINE
B-PHENYL SERINE
TAURINE
THREONINE (L, DL, D)
DL ALLO THREONINE
TRYPTOPHANE (L, DL, D)
TYROSINE (L, DL)
VALINE (L, DL, D)

ALSO—A SELECTION OF 20 PEPTIDES

**WRITE FOR
NEW
CATALOGUE**

#S 998

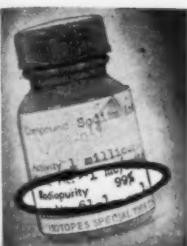
*Listing over 900
Research Biochemicals*



*Nutritional Biochemicals Corporation
CLEVELAND 28, OHIO*

Meetings & Conferences

- Sept. 14-17. Illuminating Engineering Society. New York.
- Sept. 14-17. Society of American Foresters. Colorado Springs, Colo.
- Sept. 16-18. American Fisheries Society (83rd Annual). Milwaukee, Wis.
- Sept. 21-25. National Instrument Conference. Chicago, Ill.
- Sept. 23. American Medical Writers' Association (Annual). Springfield, Ill.
- Sept. 23. Mississippi Valley Medical Society. Springfield, Ill.
- Sept. 24-25. American Society of Photogrammetry (Semi-annual). Rochester, N. Y.
- Sept. 27. American College of Dentists (Annual). Cleveland, Ohio.
- Sept. 28-Oct. 1. American Dental Association (Annual). Cleveland, Ohio.
- Sept. 28-Oct. 2. Alaskan Science Conference (4th), sponsored by AAAS, Alaska Division. Juneau, Alaska.
- Sept. 29-Oct. 1. American Institute of Electrical Engineers (Middle Eastern District). Charleston, W. Va.
- Sept. 29-Oct. 2. Aircraft Electric Equipment Conference. Seattle, Wash.
- Sept. 29-Oct. 2. American Roentgen Ray Society. Cincinnati, Ohio.
- Oct. 7-10. American Society of Automotive Engineers. Los Angeles, Calif.
- Oct. 8. British Columbia Academy of Science. Vancouver, Canada.
- Sept. 21-26. International Union of Forest Research (11th). Rome, Italy, and Sicily.
- Sept. 28-Oct. 6. International Council for the Exploration of the Sea (41st Annual). Copenhagen, Denmark.
- Oct. 3-10. International Congress of Leprosy (6th). Madrid, Spain.
- Oct. 4-11. European Confederation of Agriculture. Seville, Spain.
- Oct. 7. Ibero-Latin American College of Dermatology (2nd). Madrid, Spain.
- Oct. 7-8. International Symposium on Progress in Rubber Technology. Delft, Netherlands.
- Oct. 8-11. International Federation of National Associations of Engineers (1st). Rome, Italy.
- Oct. 9-15. International Mechanical Engineering Congress (5th). Turin, Italy.
- Oct. 12-15. International Congress on Agricultural Credit (2nd). Naples and Rome, Italy.
- Oct. 12-17. International Conference of National Committees on Vital and Health Statistics, WHO. London, England.
- Oct. 12-17. International Congress of Pediatrics and General Assembly of International Pediatric Association (7th). Havana, Cuba.
- Oct. 15. General Conference on Weights and Measures. Paris, France.
- Oct. 15-18. International Office of Documentation of Military Medicine (16th Session). Rome, Italy.
- Oct. 19-20. Latin American Associations for the Advancement of Science. Parana, Brazil.
- Oct. 19-23. International Congress of Antiparasites (1st). Naples and Rome, Italy.
- Oct. 19-23. International Congress for Plant Protection (1st). Naples and Rome, Italy.



**C-14
Labeled
Compounds
OF
HIGH
RADIOPURITY**

REGULARLY AVAILABLE COMPOUNDS

- Purines and pyrimidines
- Alcohols and alkyl halides
- Fatty Acids and Derivatives
- Guanidine
- Glycoxyamine
- Glycerol
- Hydrocarbons
- Amino acids
- Formaldehyde

CATALOG SHEETS ON REQUEST

S-102 Isotopes and Compounds for Medical Use
 S-103 Calibration Sources and Absorbers
 S-104 C-14 Tagged Compounds
 S-105 Flow Counter
 S-106 Film Badge Service

ISOTOPES SPECIALTIES CO., INC.
 3816 S. SAN FERNANDO ROAD
 GLENDALE 4, CALIFORNIA

**IMPORTANT IN
HIGH VACUUM WORK
A PIEZON®
OILS, GREASES, WAXES**

Apiezon products have the recognition of leading scientists who accord them top preference for high vacuum work. A bulletin just off the press describes the physical characteristics of a variety of special oils, greases and waxes for oil-diffusion pumps, sealing joints, stop cocks, etc. You should have a copy to augment your store of knowledge on the subject. Mailed free; simply ask for Bulletin 43-S.



JAMES G. BIDDLE CO.
 Electrical & Scientific Instruments
 1316 ARCH STREET, PHILADELPHIA 7, PA.

as STRONG as the weakest link

and in research a weak link means fruitless efforts. In spite of the finest direction and most advanced techniques many laboratory projects have failed to achieve conclusive results because of inconsistent reagents. Years of experience in guinea pig complement production have enabled Carworth Farms to produce a reagent whose uniformity and dependability has been attested to by a constantly increasing demand.

"VACSEAL" Guinea Pig Complement

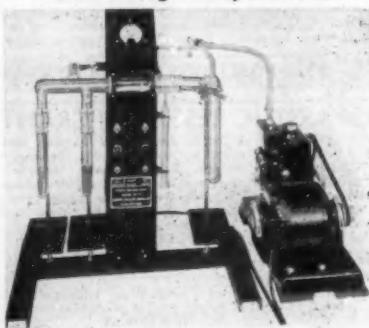
Our large output enables us to pool the serum of no less than 100 guinea pigs per lot. "VACSEAL" Complement is distributed in three sizes with a special diluent for restoration to the following amounts:

3cc. 7cc. 20cc.

For further information please write to:

**CARWORTH FARMS, INC. • NEW CITY
NEW YORK**

**FREEZE-DRYING
for Histologic Preparations**



Model FD-11

* Small, compact * semi-automatic * excellent visibility * simple, sensitive electronic vacuum gauge * drying periods regulated by size of tissue (20 permanent blocks or more can be prepared in 48 hours) * simple and efficient infiltration under vacuum.

Freeze-drying is now practical for your laboratory. We have pioneered in the simplification and improvement of histological freeze-drying equipment. Costly non-essentials are eliminated with resulting greater simplicity of operation.

Complete with accessories \$575. F.O.B. Boston

Write to Dept. S-2

SCIENTIFIC SPECIALTIES CORP.
 Snow and Union Streets Boston 35, Mass.

PERSONNEL PLACEMENT

YOUR ad here reaches over 32,000 scientists in the leading educational institutions, industrial laboratories, and research foundations in 77 countries—at a very low cost.

CLASSIFIED: 18¢ per word, minimum charge \$3.60. Use of Box Number counts as 10 additional words.

DISPLAY: Rates listed below—no charge for Box Number. Monthly invoices will be sent on a charge account basis—provided that satisfactory credit is established.

Single insertion	\$19.50 per inch
7 times in 1 year	17.50 per inch
13 times in 1 year	16.00 per inch
26 times in 1 year	14.00 per inch
52 times in 1 year	12.50 per inch

For PROOFS on display ads, copy must reach SCIENCE 4 weeks before date of issue (Friday of every week).

POSITIONS WANTED

Bacteriologist, Ph.D., wide experience, doing research, wishes teaching position. Box 177, SCIENCE. X

Biophysicist, 3 years' post-doctorate work (publications) in electron microscopy (cell structure), ultracentrifugation and diffusion technique (macromolecules) desires interesting post. Box 176, SCIENCE. X

Entomologist—Ph.D., Entomology—Parasitology; 3 years' research assistant, veterinary insects-parasites; 3 years in charge tropical research laboratory, medical insects-parasites; prefers academic position. Box 178, SCIENCE. X

Ph.D. Organic Synthesis, Pharmacology; experienced Research Chemist; young; publications; desires West. Please write Scientific Personnel Service, 122 South Michigan Ave., Chicago. X

Pharmacologist, Ph.D., 35, married, children, desires teaching and/or research. Experience CNS drugs, anti-convulsants, paralytics; cardiovascular and local anesthetics. Available reasonable notice. Box 169, SCIENCE. 9/11

Biochemist; Ph.D. (Major: Biochemistry, Organic Chemistry); particularly interested industrial research, process development; three years, organic chemist, pharmaceutical company; four years, research and development of vitamins and vitamin products. For further information, please write Science Division, Medical Bureau (Burneice Larson, Director) Palmolive Building, Chicago. X

POSITIONS OPEN

1954 ARCTIC RESEARCH GRANTS

The Arctic Institute of North America is offering research grants in 1954 for scientific investigations dealing with arctic and subarctic regions. Research must include field investigations or other appropriate activity in North America. Proposals in the physical sciences will receive special consideration. Application forms may be obtained from Arctic Institute of North America, 1530 P Street, N.W., Washington 5, D.C.; or 3485 University Street, Montreal, Canada. Completed applications must be received by 1st November 1953.

Physiologist. Grant sponsored research on effluvogram. See Sci. 116: 193. About \$4,600. M.S. or Ph.D. or equivalent experience. Write W. S. Wilde, Station 20, New Orleans 18, Louisiana. X

Two Technical Assistants; opportunities to continue studies; one with degree in zoology or allied field, West; other with biochemical training, East. Please write Scientific Personnel Service, 122 South Michigan Ave., Chicago.

Scientific Writer—Young M.D. or person with equivalent training in medical science with literary interest and talent to write technical material for the medical profession. Work involves interpretation of laboratory and clinical data on new drugs explaining composition, application, use, therapeutic action of new drug discoveries for F.D.A., scientific publications, and practising physicians. Large midwestern ethical pharmaceutical research and manufacturing organization. For further details, please write Box 159, Science.

POSITIONS OPEN

Histological Technician with good basic training in histology and experience in technique. Write Box 172, SCIENCE. 9/11, 18

(a) Director, clinical investigation; key appointment carrying membership, executive committee; internist with degree in one of sciences preferred. (b) Biochemist; laboratory department; 400-bed hospital; university town, Midwest. (c) Ph.D. in biology experienced in radioactivity work and with background in radioisotope, radiological and biological research; university school of medicine. (d) Ph.D. qualified teach pharmacy particularly dispensing and direct graduate work; rank: assistant or associate professor, eastern university. (e) Physiologist; rank dependent qualifications; one of leading universities. S9-2 Science Division, Medical Bureau (Burneice Larson, Director) Palmolive Building, Chicago. X

The MARKET PLACE

BOOKS • SERVICES • SUPPLIES • EQUIPMENT

CLASSIFIED: 25¢ per word, minimum charge \$6.00. Use of Box Number counts as 10 additional words. Correct payment to SCIENCE must accompany ad.

BOOKS AND MAGAZINES

WANTED TO PURCHASE . . . SCIENTIFIC PERIODICALS and BOOKS

SETS AND RUNS, FOREIGN
and DOMESTIC. ENTIRE
LIBRARIES AND SMALLER
COLLECTIONS WANTED.
WALTER J. JOHNSON • 125 East 23rd St., New York 10, N.Y.

YOUR SETS AND FILES OF SCIENTIFIC JOURNALS
ARE NEEDED BY OUR LIBRARY AND INSTITUTIONAL CUSTOMERS. PLEASE SEND
US LISTS AND DESCRIPTION OF PERIODICAL FILES YOU ARE WILLING TO SELL
AT HIGH MARKET PRICES. WRITE DEPT. ASS., J. S. CANNER, INC.
BOSTON 19, MASSACHUSETTS

NATIONAL GEOGRAPHIC MAGAZINES 1888-1953. ANY ISSUE. SEND WANT LIST. WILL PURCHASE GEOGRAPHICS BEFORE 1912. PERIODICAL SERVICE, BOX 465-SC, WILMINGTON, DELAWARE. 8/21

SCIENTIFIC BOOKS and PERIODICALS WANTED Complete Research — Sets and runs — Single titles

Please send us your want list

STECHERT - HAFNER, INC. 31 EAST 10TH ST., NEW YORK 3
THE WORLD'S LEADING INTERNATIONAL BOOKSELLERS

PROFESSIONAL SERVICES

LOOKING FOR A PUBLISHER?

Write for Free Booklet SC telling how we can publish your book. All subjects considered. New authors welcome. VANTAGE PRESS, INC. • 120 W. 31 ST., NEW YORK 1. IN CALIF.: 6356 HOLLYWOOD BLVD., HOLLYWOOD 28

SPECIAL GLASS APPARATUS

Our glass blowing department is available for special scientific and technical glass apparatus made to specifications and drawings. Inquiries invited. Estimates furnished.

E. MACHLETT & SON
218 EAST 23RD ST.
NEW YORK 10, N.Y.

FOOD RESEARCH LABORATORIES, INC.

Founded 1922

Philip B. Hawk, Ph.D., President

Bernard L. Oser, Ph.D., Director

Research • Analyses • Consultation
Biological, Nutritional, Toxicological Studies
for the Food, Drug and Allied Industries

48-14 33rd Street, Long Island City 1, N.Y.

- RESEARCH
- CONSULTATION
- ANALYSIS

The MARKET PLACE

BOOKS • SERVICES • SUPPLIES • EQUIPMENT



PROFESSIONAL SERVICES



Food Ingredient & New Drug Studies

DIGITALIS ASSAYS

LaWall & Harrisson

Div. S, 1921 Walnut St., Philadelphia 3, Pa.

ANALYSES • CONSULTATION • RESEARCH

Bacteriologists
Chemists • Pharmacologists

LABORATORY SERVICES

Project research and consultation in
Biochemistry, Chemistry, Bacteriology
and Entomology

Screening of compounds for insecticidal, fungicidal and bactericidal properties • Biological evaluation and chemical determination of insecticides • Peet-Grady and C.S.M.A. aerosol tests • Warfarin assays

Write for price schedule

WISCONSIN ALUMNI RESEARCH FOUNDATION
P. O. BOX 2059 • MADISON 1, WISCONSIN

SUPPLIES AND EQUIPMENT

INDEX OF REFRACTION

Shillaber's Certified Index Liquids
High Index Liquids (1.81-2.0)

Allen's Solid Refractive Index Standards
For Microscopy

Write for informative ND-S leaflets

R. P. CARGILLE LABORATORIES, INC.
117 Liberty Street • New York 6, N. Y.

FOOD FOR

Chimpanzees—Monkeys

"CHIMCRACKERS" is only food of its kind—used by leading university & private labs for over 15 years. Prepared from a formula developed in the Yerkes Laboratories of Primate Biology, Inc. Write for analysis, free sample and price list.

Kennel Food Supply Co., Fairfield, Conn.

STAINS

STARKMAN Biological Laboratory

- RARE
- COMMON
- Price list on Request
- 461 Bloor St., W.
Toronto, Canada



TACONIC FARMS

Germantown, N. Y.

Germantown 3535

- Swiss Mice
- Webster Strain

SUPPLIES AND EQUIPMENT

NEW AND USED SCIENTIFIC EQUIPMENT • • •
Microscopes, Refractometers, Colorimeters, Microprojectors, Balances, Photomicrographic Apparatus, Micrometers etc. etc. Rebuilt Instruments unconditionally guaranteed. Liberal trade-in allowance or cash for your old equipment. Ask for latest list of used equipment

TECHNICAL INSTRUMENT COMPANY
1508 Divisadero—San Francisco 15—Calif.
MAKERS OF THE FAMOUS "TIC ILLUMINATOR"

RATS

Long-Evans (PAF)
Wistar (PAF)

Bred for Research Work by Research Workers
PACIFIC ANIMAL FARMS
2457 Fletcher Dr., Los Angeles 39, Calif.

NEW MONOMERS

Acryl and Methacryl Chlorides
Allyl Esters: Acrylate, Fumarate, Maleate
Ethylene Glycol Acrylate and Methacrylate
2,2-Dimethyl Butadiene, $\alpha;\beta$ -Chlorostyrenes

300 Others Write for List A-5
MONOMER-POLYMER, INC.
511 Lancaster St. Leominster, Mass.

All AMINO ACIDS

natural, synthetic, unnatural,
Rare Sugars, Biochemical Products, Reagents, New
Pharmaceuticals in stock. Write or phone PLaza
7-8171 for complete price list.

BIOS LABORATORIES, INC. 17 West 60th Street,
New York 23, N. Y.

• HYPOPHYSECTOMIZED RATS

Shipped to all points via Air Express
For further information write

HORMONE ASSAY LABORATORIES, INC. • 8159 South Spaulding Ave.
Chicago 29, Ill.



for

- MICROSCOPES
- MICROTOMES
- ILLUMINATORS

Equipment for Photomicrography
Zeiss Specialties like Homals

Write to

**ERIC SOBOTKA CO. • 102 West 42d Street
New York 36, N. Y.**

LOOK AROUND...

notice the increasing number of satisfied advertisers using small-space ads regularly in practically every issue of SCIENCE—*proof that these small ads get results!* If you have a product or service of interest to scientists, why not take advantage of this low-cost means of increasing your profits?

APPLICATION FOR HOTEL RESERVATIONS

120th AAAS MEETING

Boston, Mass., December 26-31, 1953

The list of hotels and their rates and the reservation coupon below are for your convenience in making your hotel room reservation in Boston. Please send your application, *not* to any hotel directly, but to the AAAS Housing Bureau in Boston and thereby avoid delay and confusion. The experienced Housing Bureau will make assignments promptly; a confirmation will be sent you in two weeks or less. Share a room with a colleague if you wish to keep down expenses. Mail your application *now* to secure your first choice of desired accommodations. All requests for reservations must give a definite date and estimated hour of arrival, and also probable date of departure.

HOTELS AND RATES PER DAY

Hotel*	Single	Double Bed	Twin Beds	Suites
BRADFORD★	5.75- 6.75	8.50- 9.50	9.95-13.00	14.00-18.00
COPLEY SQUARE-CS	4.00- 5.00	6.00- 7.00	6.00- 7.00	10.00-12.00
KENMORE-BB	6.00-10.00	9.00-14.00	10.00-14.00	18.00-21.00
LENOX-CS	4.50- 6.00	6.00- 8.00	8.00-10.00	14.00-16.00
PARKER HOUSE	5.75- 8.50	9.25-10.50	11.50-14.50	21.00-22.00
SHERATON PLAZA★-CS	5.85- 7.85	9.90-15.00	11.00-15.00	25.00-30.00
SOMERSET★-BB	6.00- 9.00	10.00-14.00	12.00-14.00	18.00-20.00
STATLER★	6.00-10.00	9.00-13.00	11.00-16.50	25.00 & up
TOURAINNE	5.50- 7.50	9.50-10.50	9.75-12.00	18.00 & up
VENDOME-CS	4.50- 6.00	7.00	8.00-11.00	12.00-22.00

★Hotels starred have sessions in their public rooms. BB = Back Bay, CS = Copley Square; other hotels are downtown. The Bradford, Copley Square, Lenox, Statler, and Touraine can provide dormitory accommodations for parties of 3 to 5 at 2.75-3.00 per person. For a list of headquarters of each participating society and section, please see Association Affairs, *Science*, July 24, or *The Scientific Monthly*, July.

----- THIS IS YOUR HOTEL RESERVATION COUPON -----

AAAS Housing Bureau
Room 614-80 Federal St.
Boston, Mass.

Date of Application

Please reserve the following accommodations for the 120th Meeting of the AAAS in Boston, Dec. 26-31, 1953:

TYPE OF ACCOMMODATION DESIRED

Single Room	Desired Rate	Maximum Rate	
Double-Bedded Room	Desired Rate	Maximum Rate	Number in party
Twin-Bedded Room	Desired Rate	Maximum Rate	
Suite	Desired Rate	Maximum Rate	Sharing this room will be:

(Attach list if this space is insufficient. The name and address of each person, including yourself, must be listed.)

.....
.....
First Choice Hotel Second Choice Hotel Third Choice Hotel

DATE OF ARRIVAL DEPARTURE DATE
(These must be indicated—add approximate hour, a.m. or p.m.)

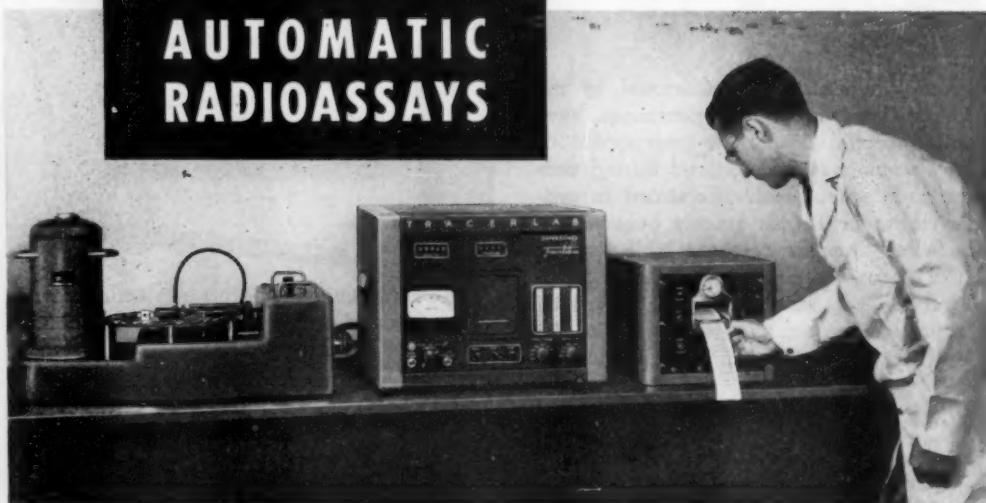
NAME
(Individual requesting reservation) (Please print or type)

ADDRESS
(Street) (City and Zone) (State)

Mail this now to the Housing Bureau. Rooms will be assigned and confirmed in order of receipt of reservation.

re in
ctly,
nced
less.
cure
and

Reliable
**AUTOMATIC
RADIOASSAYS**



Automatic sample counting with Tracerlab equipment is now standard procedure in over 300 laboratories. By adding the Automatic Sample Changer and Tracergraph Printing Timer to either the Autoscaler or Superscaler and the Shielded Manual Sample Changer, a unit is obtained which incorporates many outstanding and exclusive features. With it an extremely flexible combination of radioassay techniques can be handled with ease and precision.

Automatic equipment gives faster, more accurate and more reproducible data; results in a substantial reduction in the technician's time needed for radioassay work; frees important laboratory personnel for more productive activities. Twenty-five samples can be counted without attention, or the same number of aluminum absorbers may be placed over a sample to obtain an absorption curve automatically. A large, circular, sample disc is used, thus preventing sample cross contamination and eliminating any chance of background buildup next to the G-M tube.

Samples may be removed and changed at will, without juggling samples, and the sample changer controls can be set either for continuous operation, or for one, two or three complete cycles only, without any delay between cycles. The Tracergraph, which prints elapsed time, may also be set to time continuously without resetting to zero after each sample count for half life measurements.

All electronic controls for the Sample Changer are in the scaler to provide a wider choice of preset counts and to take full advantage of the automatic features of the scaler. Tracerlab's new Scintillation Sample Changer will also fit the Automatic Sample Changer and thus provide laboratories with a completely versatile unit.

More complete information and specifications can be found in Issue No. 50 of *Tracerlog*. A copy will be sent on request.

Tracerlab® inc.
130 HIGH ST., BOSTON
2295 SAN PABLO AVE., BERKELEY

WASHINGTON • NEW YORK • HOUSTON • ATLANTA
LOS ANGELES • PARIS • CHICAGO • CLEVELAND

New Sealed Accessories

FOR CENTRIFUGING INFECTIOUS MATERIALS

Purpose

Laboratory administrators interested in the health of their laboratory personnel have recently become concerned with infectious aerosols sometimes encountered during centrifuging. Infectious materials sealed in centrifuge tubes or bottles quickly become airborne when they are released by a leak or fracture of the container due to high centrifugal forces. The natural draft created by the fan action of the rotating head acts to distribute the material through the laboratory.

Approach

International Equipment Company engineers have adapted standard accessories to permit sealing of the centrifuge cup. To insure maximum safety, the scientist having completed centrifuging removes the sealed container to a hood for opening. In those instances where a leak or fracture has allowed the material to contaminate the container, immediate decontamination steps may be taken.

Solution

A series of accessories based upon the Hi-speed 250 ml. slotted cup has been designed. The standard cup is threaded to take a dome cover fitted with an O-ring seal. The cup holds one of the standard round or flat bottom 250 ml. centrifuge bottles. Adapters are available for holding: 2-50 ml. centrifuge tubes; 7-15 ml. centrifuge tubes; and 10-13 x 100 mm. serum tubes.

Centrifuge	Head	No. Cups	R.P.M.	R.C.F.
Size 1, Model SBV	277	4	3000	2000
Size 2, Model V...	277	4	2900	1880
Size 2, Model V...	266	6	2300	1410
Model PR-1.....	284	4	2400	1240



2734

989 Adapter

2734 Cup



2738

2734 — Duralumin Cup, 250 ml., with screw dome cover and gasket, including 582 rubber cushion — \$36.00.

2738 — Wrench, spanner type for tightening screw dome on 2734 — \$1.75.



2741



989



2740

2741 — Adapter, 2-place, for 50 ml. centrifuge tubes, fits 2734 or any standard IEC 250 ml. centrifuge cup — \$4.50.

989 — Adapter, 7-place, for 15 ml. centrifuge tubes, fits 2734 or any standard IEC 250 ml. centrifuge cup — \$18.00.

2740 — Adapter, 10-place, for 13 x 100 mm. serum tubes, will fit 2734 or any standard IEC 250 ml. centrifuge cup — \$21.50.

277 — Head, 4-place, steel pin type for 2734 or 384 cups — \$63.00.

266 — Head, 6-place, steel pin type for 2734 or 384 cups — \$95.00.

284 — Head, 4-place, steel pin type for 2734 or 384 cups — \$67.00.

OBtainable now from your laboratory supply dealer

INTERNATIONAL EQUIPMENT COMPANY

1284 SOLDIERS FIELD ROAD, BOSTON 35, MASS.

